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Scientific and Technical Information Division
National Aeronautics and Space Administration

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VOLUME 2 NUMBER 21

Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

November 8, 1964

01 GENERAL

Includes administration and management; space law and related legal matters; legislative hearings and documents; and symposia or conferences of a broad or general nature.

N64-29076 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
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8 Jun. 1964 295 p refs Transl. into ENGLISH of the book "Kosmicheskiye Issledovaniya, Tom II, Vypusk 2" Moscow, Izd. Nauka, 1964 p 3–173
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N64-29094 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ON THE FORTHCOMING SYMPOSIUM AND ANNUAL MEETING OF THE COMMITTEE ON SPACE RESEARCH (COSPAR)
I. V. Milovidov *In its* Cosmic Res., V. 2, No. 2 8 Jun. 1964 p 272–294 (See N64-29076 21-01)

The agenda for the symposium and annual meeting held in Florence from May 7 through May 20, 1964, is outlined. The following areas were chosen for discussion: (1) space physics—the interaction of high-energy particles with atmosphere; (2) space biology and exobiology—biological experiments on satellites (a survey of modern results) and manned spaceflight basic physiological and psychological problems and discoveries; and (3) the latest results and discussions of theoretical questions in space investigations involving rockets and satellites. I.v.L.

N64-29406* Stanford Research Inst., Menlo Park, Calif. Poulter Research Labs.
FEASIBILITY STUDY OF AN EXPLOSIVE GUN Final Report
G. R. Fowles, W. M. Isbell, and F. H. Shipman 5 Jul. 1964 81 p refs
(Contract NAS2-1361; SRI Proj. GSU-4511)
(NASA-CR-58677) OTS: $8.10 ph

The results of a study of the feasibility of an explosive system that makes use of an explosive to drive a piston, which acts, essentially, as the pump piston of a "constant velocity reservoir" light-gas gun, are discussed. The system is based on the idea that if a piston of substantial mass can be launched at high velocity by explosive acceleration, and if through a controlled collision part of its energy and momentum can be transferred to a projectile of controlled shape while maintaining projectile acceleration within acceptable bounds, then a very high-performance gun will result. A number of explosive arrangements were tested in an attempt to find an acceptable combination of explosive charge and collapsible gun-barrel liner. An arrangement, consisting of nitromethane explosive concentric about a glass tube, was found to produce an acceptable combination of explosive charge and collapsible tube-barrel liner. Included is an approximate treatment intended to provide a means of easily estimating the theoretical ultimate projectile velocity for prescribed initial conditions. P.V.E.

N64-29494* National Aeronautics and Space Administration. Washington, D.C.
ADDRESS BY JAMES E. WEBB, ADMINISTRATOR, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
25 Sep. 1963 18 p Presented at the Ann. Meeting of Tex. Midicontinent Oil and Gas Assn., Houston Available from the Scientific and Technical Information Division

The background leading to the passage of the National Aeronautics and Space Act of 1958, and the achievements of NASA since that time are discussed. In addition, the status of international cooperation in the field of space exploration is outlined. P.V.E.

N64-29539* National Aeronautics and Space Administration, Washington, D.C.
TENTH SEMIANNUAL REPORT TO CONGRESS, JULY 1–DECEMBER 31, 1963
[1964] 243 p refs GPO: $1.00

A report is presented of NASA projects and progress. Many accomplishments in the national space program are given in summary, as well as in detail. In addition to knowledge-garnering launches and technological developments, NASA has further strengthened the base for greater progress in the future. Program phases discussed are these: (1) manned spaceflight; (2) scientific investigations; (3) satellite applications; (4) advanced research and technology; (5) nuclear propulsion and power generation; (6) tracking and data acquisition; (7) international programs; (8) university- and basic-research programs; (9) informational programs; and (10) personnel, management, procurement, and support functions. I.v.L.

N64-29588 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
PRICE PER TON-KILOMETER
F. Sadchikov 21 Aug. 1963 6 p Transl. into ENGLISH from Grazhdanskaya Aviatsiya (Moscow), no. 3, 1963 p 9
(FTD-TT-63-789/1; AD-420613)

The economics of aircraft scheduling for both cargo and passenger service are investigated. Some areas where economies have been or could be effected are suggested. These include more stops on the local airlines, organizing production, reducing the norms for nonproductive flying time, reducing fuel and oil consumption as compared to the norms, and crew reduction by elimination of the navigator and the flight mechanic especially on the local airlines. M.P.G.

N64-29950 RAND Corp., Santa Monica, Calif.
MAGIC, MATHEMATICS, AND MYSTERY
Richard Bellman Jun. 1964 11 p Presented to the Joint Autom. Control Comm., Palo Alto, Calif., 24 Jun. 1964
(P-2930)

Magic, mathematics, and mystery, and their places in the field of science are discussed. The scientist objects to the invocation of magical explanations and supernatural causes in explaining scientific phenomena. However, electricity, and certainly gravitation, are as magical in their properties as any soothsayer or haruspex could possibly wish. But a very large number of occurrences and effects can be explained in terms of a few quite simple causes and assumptions. The language of science is mathematics. In celestial mechanics the flowering of the mathematical method in the physical sciences is seen. The ability of Newtonian techniques to predict the behavior of the planets, the moons, the comets, and the tides is uncanny. It is said that the great French mathematicians, Laplace and Lagrange, could not believe that the observed celestial behavior could be predicted by using such simple equations as those deduced from Newton's laws of motion. For those who insist upon challenge and mystery, who pride themselves on tackling only the most difficult problems of their times, the following is offered: the puzzles of the reproductive capacity of a single cell, the memory (or memories) of the brain, the operation of the nervous system, etc. I.v.L.

N64-30012 Applied Physics Lab., Johns Hopkins U., Silver Spring, Md. Chemical Propulsion Information Agency
PROCEEDINGS OF THE EIGHTH MEETING OF THE ICRPG WORKING GROUP ON DESIGN AUTOMATION
[1964] 30 p Meeting Held at NASA. Marshall Space Flight Center, Huntsville, Ala., 16 Apr. 1964
(Contract NOw-62-0604-c)
(CPIA-48; AD-440309)

Short abstracts are given of the following: (1) The Analysis of Temperature and Stress in Solid Propellant Grains, and (2) Practical Applications of Aerodynamic Theory for Determining Load Distribution on Bodies of Revolution. Brief reports from performance, design, and evaluation subcommittees are included. R.L.K.

02 AERODYNAMICS OF BODIES, COMBINATIONS, AND INTERNAL FLOW

Includes aerodynamics of channels, cowls, ducts, ejectors, nozzles, etc. *For related information see*: 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 11 Fluid Mechanics.

N64-29212* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

STATIC AERODYNAMIC CHARACTERISTICS OF BLUNTED CONES AND ROUND-SHOULDERED CYLINDERS SUITABLE FOR PLANETARY ENTRY VEHICLES AT A MACH-NUMBER RANGE 1.65 TO 9.00

James Nichols and Edward Nierengarten 15 Feb. 1964 295 p refs

(Contract NAS7-100)

(NASA-CR-58666; JPL-WT-20-558)

Wind-tunnel Test 20-558 was a test of models with high-drag, nonlifting configurations suitable for entry into planetary atmospheres. The purpose of the test was to obtain basic, static, aerodynamic characteristics for these shapes. Normal and axial forces and pitching moments were measured with a strain-gage balance, and the center-of-pressure positions along the longitudinal axis of the body were calculated. The test was conducted in two phases. The first phase was performed in the 20-in. supersonic wind tunnel at Mach 1.65, 2.0, and 3.0, with corresponding Reynolds no./in. of 0.32×10^6. The second phase was performed in the 21-in. hypersonic wind tunnel at Mach 5.0 and 9.0, and Reynolds no./in. of 0.141×10^6 and 0.103×10^6, respectively. The angle-of-attack was varied from $-1°$ to $+20°$ for the first phase of the test, and $-3°$ to $+19.3°$ for phase two. Author

N64-29496* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

LONGITUDINAL CHARACTERISTICS OF SEVERAL CONFIGURATIONS AT HYPERSONIC MACH NUMBERS IN CONICAL AND CONTOURED NOZZLES

James P. Arrington, Roy C. Joiner, Jr., and Arthur Henderson, Jr. Washington, NASA, Sep. 1964 74 p refs

(NASA-TN-D-2489) OTS: $2.00

Pointed cones, a slender cone-cylinder, a winged ellipsoid, and several cylindrical configurations have been tested in helium in a contoured nozzle at a Mach number of 20.5 and in a conical nozzle at a Mach number of about 24. The effects of flow in a conical nozzle on the aerodynamic characteristics of pointed slender bodies can be appreciable, and the extent can vary with model geometry and position. The Mach number at the model, rather than an average over the entire core, should be used in reducing the data obtained in hypersonic nozzles; otherwise, large discrepancies may occur in the aerodynamic results. Author

03 AERODYNAMICS OF WINGS, ROTORS, AND CONTROL SURFACES

Includes ailerons; airfoil sections; cascades; fans; flaps; propellers; rotors; slats; spoilers; etc. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 11 Fluid Mechanics.

N64-29028 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CALCULATION AND EXPERIMENTAL INVESTIGATION OF AUTOOSCILLATIONS OF CYLINDRICAL SHELLS AND PANELS IN A GAS FLOW

R. Ye. Lamper and L. G. Shandarov 25 Mar. 1964 15 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow), no. 3, 1963 p 58–64

(FTD-TT-63-1227/1+2; AD-436841)

The dynamic stability of short cylindrical shells and of short curvilinear panels of finite length, in a supersonic gas flow, is discussed. The rate of flow is parallel to the "formers." The excess aerodynamic pressure Δp, originating during perturbed motion, is considered by the formula $\Delta p = A_1 \delta w/\delta x + A_2 \delta w/\delta t$. Here, w is the radial displacement, and A_1 and A_2 are constants. In addition, the behavior of panels in supersonic flow, with a change in axial stresses, was experimentally investigated. On a panel stretched or compressed by small stresses, local weak vibrations appeared. At further changes in stresses, auto-oscillations developed, enveloping basically the rear section of the panel. These oscillations may have the form of either slanting waves, the front of which straighten out toward the rear edge, or traveling waves of approximately rhombic form. A subsequent increase in compression leads to intense oscillations with maximum amplitudes in the rear section, accompanied by deep folds and sometimes collapse. I.v.L.

N64-29207* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

WIND-TUNNEL MEASUREMENTS ON A LIFTING ROTOR AT HIGH THRUST COEFFICIENTS AND HIGH TIP-SPEED RATIOS

George E. Sweet, Julian L. Jenkins, Jr., and Matthew M. Winston Washington, NASA, Sep. 1964 56 p refs

(NASA-TN-D-2462) OTS: $1.50

Results are presented from an investigation of the performance and static stability characteristics of a 15-ft-diam rotor operating at conditions expected to produce large amounts of blade stall. Rotor forces, power, and flapping motions were recorded for rotor tip-path-plane angles-of-attack of 10.5°, 0.5°, and −9.5° at tip-speed ratios from 0.25 to 0.56. Portions of the data are compared with theoretical calculations. At theoretically unstalled operating conditions, the agreement between measured and calculated rotor thrust was good. However, when rotor-blade stall was theoretically predicted, thrust measurements did not indicate the large blade lift losses predicted by theory. Author

N64-29331 Aeronautical Research Council (Gt. Brit.)

THE CHARACTERISTICS OF SOME SLENDER CAMBERED GOTHIC WINGS AT MACH NUMBERS FROM 0.4 TO 2.0

L. C. Squire London, HMSO, 1964 50 p refs

(HRC-R&M-3370; Replaces RAE-AERO-2663; ARC-24258)

HMSO: 18s 6d

Wind-tunnel tests have been made on a series of cambered slender wings of modified gothic planform. The main purpose of these tests was to investigate camber designs that have low lift-dependent drag and a given center-of-pressure position ahead of the aerodynamic center. The results show that at the design conditions the center-of-pressure position is close to, or slightly ahead of, the design position, and the trimming power associated with the forward position of center of pressure is largely maintained throughout the speed range. The maximum lift–drag ratios of the cambered wings are slightly greater than those of the uncambered wing. Author

N64-29769 Polish Academy of Sciences, Warsaw
INFLUENCE OF GROUND PROXIMITY ON AERODYNAMIC FORCES ON AN OSCILLATING TILTED AIRFOIL
W. Fiszdon, W. Lucjanek, and M. Nowak [1964] 18 p refs Presented at the 4th Cong. of the Intern. Council of the Aeronautical Sci., Paris, 24–28 Aug. 1964
(AIAA Paper-64-563) AIAA: $0.50 members; $1.00 nonmembers

A qualitative investigation was made of the influence of the ground deflection of the wake of tilted wing aircraft on the flutter derivatives. A linearized two-dimensional, incompressible, nonviscous flow was considered, and it was assumed that the airfoil is very thin, and the vortices follow the main streamline that is undisturbed by the presence of the airfoil. Calculations were made for the following parameters: tilt angles of 30°, 45°, 60°, and 75°; heights of 2, 3, 4, 6, and 10 half-chord lengths; and frequency parameter values of 0.05, 0.1 0.2, 0.5, 1.0, 1.5, 2.0, 2.5. The results indicate that relatively small changes in coupling moments and force coefficients significantly affect flutter, particularly for frequency coefficients $k < 1$, but no definite statements can be made concerning the effect of ground proximity on the critical flutter velocity. M.P.G.

N64-30100* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
COMPARISON OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS OF CURVED AND STRAIGHT LEADING-EDGE DELTA WINGS AT MACH NUMBERS 3 AND 6
Dewey E. Wornom and Joseph Gera Washington, NASA, Sep. 1964 24 p refs
(NASA-TN-D-2486) OTS: $0.75

Force tests have been conducted of three slab-sided delta planform wings, one with a straight leading edge and two with curved leading edges. One curved wing had constant spanwise leading-edge radius and wing thickness and for the other curved wing, the leading-edge radius and wing thickness decreased linearly over the span. The longitudinal characteristics of the three wings were measured over an angle-of-attack range from −5° to approximately 13°. The Reynolds numbers per foot were approximately 2.26 and 0.91×10^6 at Mach numbers of 3 and 6, respectively. Substantial reductions in drag coefficient with no appreciable difference in lift and pitching-moment characteristics were noted for the curved leading-edge wings as compared with the straight leading-edge wing.
Author

N64-30187 Massachusetts Inst. of Tech., Cambridge Fluid Dynamics Group
PURE BENDING FLUTTER OF A SWEPT WING IN A HIGH DENSITY, LOW SPEED FLOW
John Dugundji and Nancy Ghareeb Mar. 1964 84 p refs
(Contract Nonr-1841(81))
(Rept.-64-1; AD-602830) OTS: $4.00

The pure bending flutter of a uniform, high aspect ratio, swept wing is studied in detail. Velocity component aerodynamic strip theory is used with both quasi-steady and unsteady Theodorsen function representations. The problem is nondimensionalized, and exact solutions are obtained, thereby eliminating problems of modal convergence. Effects of structural damping and below-flutter response are also examined.
Author

04 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc., and specific types of complete aircraft (e.g., Ground Effects Machines, Flexible Wings, STOL, and VTOL); flight tests; operating problems; safety devices; and stability and control. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 30 Space Vehicles.

N64-29234 Aeronautical Research Council (Gt. Brit.)
8 FT × 8 FT TUNNEL TESTS ON A MODEL OF THE DE HAVILLAND 'BLUE STREAK'
G. F. Moss and D. Issacs London, HMSO, 1964 51 p refs
(ARC-CP-734; replaces RAE-TN-AERO-2770, ARC-23743)
HMSO: 10s 6d

Six component balance tests have been made on a 1/30th scale model at Mach numbers from 0.95 to 2.80. Some measurements of static pressure over the engine pods were made, and an investigation of the dynamic stability in pitch was carried out. The results show that there are significant effects due to head shape and fins on the size of the destabilizing pitching moments in a typical trajectory. The effect of body vortices on the measured static pressure is shown, and the derived negative aerodynamic damping coefficients are given. The reason for the latter is shown to be the presence of a step in the body profile, but the total damping is likely to be adequate for the rigid mode on the full scale missile.
Author

N64-29330 Aeronautical Research Council (Gt. Brit.)
A CONTRIBUTION TO THE THEORY OF AIRCRAFT RESPONSE IN ROLLING MANOEUVRES INCLUDING INERTIA CROSS-COUPLING EFFECTS
H. H. B. Thomas and P. Price London, HMSO, 1964 65 p refs
(ARC-R&M-3349; replaces RAE-AERO-2634; ARC-22301)
HMSO: £1 5s

The problem of calculating the response of an aircraft in rolling maneuvers when the mass distribution of the aircraft is such that the inertia terms in the equations of motion effect a cross coupling of the usual lateral and longitudinal motions is considered. Solutions are outlined to two formulations of this problem: (1) response to a given applied aileron; and (2) response corresponding to a specified time history of rate of roll. Detailed calculations are made only for the first of these, and the results compare favorably with digital-computer solutions. Possible simplifications to the method of calculation are discussed.
Author

N64-29383 Aeronautical Research Council (Gt. Brit.)
THE MEASURED RESPONSE OF AN AIRCRAFT TO THE VERTICAL VELOCITY COMPONENT OF ATMOSPHERIC TURBULENCE
D. M. Ridland London, HMSO, 1964 40 p refs
(ARC-CP-708; replaces RAE-TN-AERO-2866, ARC-24817)
HMSO: 7s

Measurements have been made of the rigid body response in the pitching plane of an aircraft to the vertical velocity component of atmospheric turbulence. Spectral methods were used to evaluate the aircraft frequency response functions, which agreed very well with theoretical predictions. Limited analysis of the measured elevator movement suggests that the

pilot is the dominant factor in aircraft response at very low frequencies during flight through atmospheric turbulence. Author

N64-29511* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A STUDY OF NONLINEAR LONGITUDINAL DYNAMIC STABILITY
Murray Tobak and Walter E. Pearson Washington, NASA, Sep. 1964 40 p refs
(NASA-TN-R-209) OTS: $1.00

Principles from functional analysis are used as the framework for a reformulation of the notions of aerodynamic indicial functions and superposition. An integral form for the aerodynamic pitching-moment coefficient is derived that is free of dependence on a linearity assumption. Results are applied to the study of nonlinear longitudinal dynamic stability. Implications of the results are discussed, especially in regard to the meaning of experimental determinations of nonlinear aerodynamic damping derivatives. Author

N64-29530 Boeing Co., Seattle, Washington
THE SUPERSONIC TRANSPORT
Edward C. Wells 15 Sep. 1964 39 p Presented at the Intern. Air Transport Assn. Symp., Bogota, 15 Sep. 1964 Includes Photographs
(S-8118)

This report is transcript of a slide-lecture on the supersonic transport (SST). Items discussed and illustrated are these: (1) flight view; (2) general arrangement of the aircraft; (3) ramp servicing; (4) liftoff and approach speeds; (5) takeoff and landing-field lengths; (6) takeoff and landing noise; (7) sonic-boom flight and overpressure profiles; (8) low-altitude turbulence effects on boom signature; (9) SST speed selection; (10) aircraft sizing; (11) DOC sonic-boom trade; (12) DOC range trade; (13) economic comparisons—supersonic vs subsonic; and (14) SST DOC evaluation. I.v.L.

N64-29590 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE FLYING CRANE
Karl-Dieter Seifert 22 Aug. 1963 7 p Transl. into ENGLISH from Aerosport (Germany) no. 4, 1963 p 148–149
(FTD-TT-63-801/1; AD-420609)

The operation of helicopters of the Mi-4 Lufthansa type as flying cranes is described; the special features that should be incorporated in helicopters designed specifically for crane service are discussed; and the overall economic advantages of helicopter cranes are considered. M.P.G.

N64-29591 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
FLYING APPARATUSES TODAY AND TOMORROW
V. Myasishchev 3 Sep. 1963 11 p Transl. into ENGLISH from RUSSIAN
(FTD-TT-63-890/1+2; AD-420600)

A general review of the maximum speed, altitude, and range of present aircraft and of expected developments in commercial aviation is presented. Supersonic aircraft designs and the problems associated with flight at supersonic speeds are discussed. Passenger transportation in hypersonic and orbital spacecraft is predicted, and the problems associated with their development are considered. M.P.G.

N64-29710 Kaysam Corp. of America, Patterson, N.J.
DEVELOPMENT OF 100,000-FOOT, DUAL-PURPOSE, FAST-RISE BALLOON Final Report, 1 Jun. 1962–31 Oct. 1963
Eric Nelson [1963] 113 p
(Contract DA-36-039-SC-89116)
(AD-602760) OTS: $4.00

Two high-modulus neoprene compounds were evaluated for use in the head balloon of a streamlined assembly. One of these compounds was based on Neoprene 673, which develops high modulus through crystallinity; the other was based on Neoprene 750, the high modulus being obtained by the use of a reinforcing filler. Two natural latex compounds having the desired physical properties for both the head balloon and the streamlined tail were also designed. A simple wind tunnel was used in an effort to determine the wind resistance of prototypes of streamlined balloons. The assembly of various types of streamlined balloons is described. Originally, a high-altitude balloon was enclosed in a two-piece, streamlined balloon, the latter having two necks. The neck of the high-altitude balloon protruded through one neck of the streamlined balloon, and the radiosonde was attached with a cord to each neck. The results obtained with this assembly were improved when the wall thickness of the outer balloon was reduced to lessen the shock on the inner balloon when the outer balloon ruptured. Author

N64-29717 Bell Aerosystems Co., Buffalo, N.Y.
X-22A TRI-SERVICE V/STOL AIRCRAFT Monthly Progress Report No. 1, 1–31 Dec. 1962
A. J. Marchese 15 Jan. 1963 38 p
(Contract NOw-63-0118-ci)
(Rept.-2127-933001; AD-442855)

Preliminary X-22A research aircraft layouts, contours, and calculation reviews of various configurations, together with trade-off, performance, and weight studies mark the initial effort during this report period. The designs finalized by this effort are being applied to the various wind-tunnel airplane models planned for this program. Author

N64-29718 Bell Aerosystems Co., Buffalo, N.Y.
X-22A TRI-SERVICE V/STOL AIRCRAFT Monthly Progress Report No. 6, 1–31 May 1963
A. J. Marchese 15 Jun. 1963 39 p
(Contract NOw-63-0118-ci)
(Rept.-2127-933006; AD-442862)

Revisions were made to the wing and fin areas to improve longitudinal and directional stability in work. Reviews and refinements to designs to reduce the weight increases due to these changes plus estimated weights of the control system are progressing. Studies to improve the longitudinal and directional stability as a result of the 1/8-scale wind-tunnel testing have been completed. The wind-tunnel program, design, fabrication and test has been revised, reflecting the necessary redesigns as a result of the 1/6-scale-model test data. Author

N64-29719 Bell Aerosystems Co., Buffalo, N.Y.
X-22A TRI-SERVICE V/STOL AIRCRAFT Monthly Progress Report No. 10, 1–30 Sep. 1963
A. J. Marchese 15 Oct. 1963 50 p
(Contract NOw-63-0118-ci)
(Rept.-2127-9330010; AD-442863)

Design has progressed in the layout and detailing of systems based on wind-tunnel test results. Releases have been made for fabrication, and extra design effort was continued in

the flight control system. Reduction of wind tunnel data from the 1/6 scale, 1/7 scale, and other models progressed. Acoustic noise tests were made. Author

N64-29720 Bell Aerosystems Co., Buffalo, N.Y.
X-22A TRI-SERVICE V/STOL AIRCRAFT Monthly Progress Report No. 11, 1–31 Oct. 1963
A. J. Marchese 15 Nov. 1963 48 p
(Contract NOw-63-0118-ci)
(Rept.-2127-933011; AD-442858)

Design progress on the Model X-22A Tri-Service V/STOL Research Aircraft to the point where drawings are being released to manufacturers for fabrication of parts is reported. Weight-control effort is being maintained, with some adjustments resulting from subcontracted systems and changes authorized after cockpit mock-up inspection. Reduction of data from wind-tunnel testing of 1/5-scale, 1/7-scale, and ground-effects models is progressing, and preparations are being made for continued wind-tunnel model tests. Acoustic-noise test of the fuselage test specimen, as well as salt spray tests and low-cycle high-stress fatigue tests of maraging steel specimens, were completed. The use of PERT, including analysis and review of PERT plans, is resulting in improved overall support and control of the program. M.P.G.

N64-29721 Bell Aerosystems Co., Buffalo, N.Y.
X-22A TRI-SERVICE V/STOL AIRCRAFT Monthly Progress Report No. 17, 1–30 Apr. 1964
A. J. Marchese 15 May 1964 43 p
(Contract NOw-63-0118-ci)
(Rept.-2127-933017; AD-442859)

Almost all engineering drawings of the X-22A Tri-Service V/STOL aircraft have been submitted to manufacturing for fabrication. Aircraft weight remains within target tolerances. Scale-model testing is progressing with a 1/20-scale spin model; the 1/5-scale model test data are being analyzed; a 1/3-scale powered duct model has been rebuilt; and the full-scale duct and propeller model is being assembled. Fabrication and setup of both the propulsion test stand and the flight control and hydraulic test stand have been completed. Essentially all major schedule problem areas have been resolved, and the contractual program delivery and V/STOL flight dates are being maintained. M.P.G.

N64-30025 Aeronautical Research Council (Gt. Brit.)
THE RELATIONSHIP BETWEEN UPWARD ACCELERATIONS AND MEAN ASSOCIATED DOWNWARD ACCELERATIONS EXPERIENCED BY AIRCRAFT IN MANEUVERING FLIGHT
E. Marjorie Owens London, HMSO, 1964 29 p
(ARC-RM-3372; Replaces RAE-TN-STRUCT-297; ARC-23441)
HMSO: 12s

When assessing the fatigue life of an aircraft structure, it is necessary to know the frequency of occurrence of upward accelerations and the magnitude of the downward acceleration to be associated with those upward accelerations. Analysis of V-g records from a variety of fighter, training, and light-bomber aircraft shows that the mean downward acceleration associated with an upward acceleration can be represented by part of a conic, whose characteristics depend on the type of aircraft, until the upward acceleration exceeds a certain value, when the downward acceleration becomes constant. Author

N64-30096* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FLIGHT INVESTIGATION OF STABILITY AND CONTROL CHARACTERISTICS OF A 1/9-SCALE MODEL OF A FOUR-PROPELLER TILT-WING V/STOL TRANSPORT
William A. Newsom, Jr. and Robert H. Kirby Washington, NASA, Sep. 1964 43 p refs
(NASA-TN-D-2443) OTS: $1.25

The tests included hovering flights in and out of ground effect and level flight and descent conditions in the transition speed range. No artificial stabilization was used in any of the tests. Even though the model was statically and dynamically unstable for many of the flight-test conditions, it could generally be controlled and maneuvered easily. The descent tests showed that the configuration had at least a 6° descent capability with no adverse effects, and that an additional 3° or 4° of descent angle was available before completely unacceptable flying qualities were encountered as a result of wing stalling. In all flight regions, the minimum total control powers found to be satisfactory in the model flight tests were less than the control powers planned for the full-scale aircraft. Author

N64-30118 Oklahoma U. Research Inst., Norman
ENGINEERING SURVEY OF AIRCRAFT STRUCTURAL FAILURES CAUSED BY CORROSION, FATIGUE, AND ABRASION Final Report, Jun. 10, 1963–Jan. 31, 1964
Gene M. Nordby Fort Eustis, Va., Army Transportation Res. Command, Jul. 1964 33 p
(Contract DA-44-177-AMC-98(T))
(TRECOM-TR-64-36; AD-605325)

A survey of Army aircraft structural failures caused by corrosion, fatigue, and abrasion was made to define critical areas of future structural research. The primary source of data was the Army failure reports, "Equipment Improvement Recommendation." Analysis of all data revealed four significant problem areas: (1) corrosion and fatigue of primary airframe structure; (2) separation of metal bonded joints on rotor blades; (3) erosion of rotor blade leading edges; and (4) sustaining rotor blade balance. Author

N64-30133 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
IN 1973 YOU WILL TRAVEL AT 2330 KM/HOUR
Constantin Sabin Ioan 14 Jul. 1964 15 p Transl. into ENGLISH from Stiinta si Tehnica (Bucharest), v. 15, no. 12, 1963 p 26–29
(FTD-TT-64-575/1+2+3+4; AD-603458)

The possibilities of building a passenger-carrying supersonic aircraft within a few years is discussed. The technical-economic characteristics these planes must have to fly at speeds twice as fast as sound and how they will look as built to such specifications are described. Also discussed are the propulsion systems needed and the problem of sonic boom. A.W.

05 ASTRONOMY AND ASTROPHYSICS

Includes celestial mechanics; and radioastronomy. *For related information see*: 12 Geophysics, and 29 Space Sciences.

N64-29088 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

SOME ESSENTIAL-NONLINEAR DEPENDENCES IN THE PHYSICAL MODELS OF PLANETS

V. M. Vakhnin *In its* Cosmic Res., V. 2, No. 2 8 Jun. 1964 p 194–207 refs (See N64-29076 21-01)

Some essential nonlinear dependences associated with the thermal regime of the surface of the planets is discussed. Emphasis is place on meteorological aspects, and no definite planet is analyzed. The general character of k_T (the coefficient taking the difference of those thermal characteristics of the planet from the "standard" into account), which is determined by k_0 (the proportionality factor), is examined as to its dependence on the averaged parameter T_{av}. The dependence of the magnitude of k_T on such factors as the presence, area, and "power" of the snow, ice, and water covers; the intensity of the heat transfer by atmospheric circulation; and the presence in the atmosphere of substances creating the "greenhouse effect," etc., are examined. In addition, bifraction related to the thermal regime of planets is discussed. Results of this examination point to the necessity of taking the essential nonlinear phenomena into consideration when using the method of transformation in the comparison of planets. I.v.L.

N64-29221* New Mexico U., Albuquerque Engineering Experiment Station

THE CONCEPT OF DIFFERENTIAL REFLECTIVITY AS APPLIED TO A SMOOTH MOON Semi-Annual Status Report, 1 Nov. 1963–30 Apr. 1964

Ahmed Erteza, James A. Doran, and Donald H. Lennert Aug. 1964 39 p refs

(Grant NsG-129-61)

(NASA-CR-58716; EE-114) OTS: $3.60 ph

An exact solution describing the radar return from a simple geometric shape and its application to the case of an idealized moon are presented. A concept that proved useful in the development of the theory is that of "differential reflectivity," a dyadic quantity that, when multiplied by a differential surface area and the vector field incident on that area, results in an expression of the contribution of that surface element to the scattered field at an arbitrary observation point. The differential reflectivity is a function of the location and orientation of the reflecting surface with respect to the observation point, the properties in the incident and reflecting media, and of the frequency of the incident radiation. Therefore, one or more of the parameters may be varied statistically to permit evaluation of the return from a body having a given statistical distribution in surface heights, together with a given distribution in slopes. D.S.G.

N64-29375 American Meteorological Society, Boston, Mass.

INVESTIGATION OF VARIOUS FORMATIONS ON MARS [OB ISSLEDOVANII RAZLICHNYKH OBRAZOVANII NA MARSE]

N. P. Barabashov Feb. 1964 32 p refs Transl. into ENGLISH from Astron. Zh. (USSR), v. 29, no. 5, 1952 p538–555

(Contract AF 19(628)-3880)

(T-R-424; AD-602194)

Among the basic results of Martian observations discussed in this report are these: (1) The various regions of the Martian seas have different albedos. The seas contain greenish and bluish regions, as well as reddish and yellow ones. (2) Certain dark areas observed are moist regions of the Martian continent. Their color does not vary with the meridian altitude of the Sun. (3) The color changes, with the meridian altitude of the Sun, in a large number of areas in the seas, viz., the region becomes red with decreasing altitude and becomes blue with increasing altitude. (4) The increase in greenness and the color variations of the Martian continent and seas do not contradict the hypothesis that vegetation develops in these regions. (5) There are regions on the Martian continent whose albedo reaches 0.448 in red, 0.190 in yellow, and 0.193 in green. (6) The polar caps of Mars are reddish. The atmospheric portion of the polar cap is probably identical with the bright areas of the eastern and western limbs of the disc of Mars, which gives the impression of four polar caps located at the ends of two mutually perpendicular diameters on the planetary disc. This indicates that there is very little moisture on Mars. (7) The atmosphere of Mars often becomes turbid, apparently because of fine ice crystals at great heights in the atmosphere. I.v.L.

N64-29387* Maryland U., College Park

HIGH-DENSITY BEHAVIOR AND DYNAMICAL STABILITY OF NEUTRON STAR MODELS

C. W. Misner and H. S. Zapolsky Repr. from Phys. Rev. Letters, v. 12, no. 22, 1 Jun. 1964 p 635–637 refs

(Grant NsG-436)

Some common features are reported of a variety of models for "cold" neutron stars in hydrostatic equilibrium, which cover qualitatively the whole range of possibilities for core models onto which relatively thin atmospheres can be joined. In particular, it is argued that ignorance of the equation of state of matter above nuclear densities is irrelevant to the question of the existence and value of a maximum mass that can exist in cold static equilibrium, and that dynamically stable solutions exist for all masses below this maximum. Author

N64-29440 Oslo U., Blindern (Norway) Institute of Theoretical Astrophysics

MASS LOSSES THROUGH EVAPORATION FROM A COMPLETELY IONIZED ATMOSPHERE WITH APPLICATIONS TO THE SOLAR CORONA Scientific Report No. 20

Eberhart Jensen 10 Feb. 1964 31 p refs *Its* Astrophysica Norvegica vol. VIII, no. 5

(Contract AF 61(052)-186)

(AFCRL-64-617; AD-444687)

Evaporative losses from an ionized hydrogen atmosphere with spherical symmetry and no magnetic fields are investigated. The approach is based on an expression for the mean free path in a medium of variable density in the case of a Coulomb collision cross section. An equation for the opening angle in the cone of escape as a function of position and velocity for a density distribution of the form r^{-n} is obtained. The evaporation rate is calculated using a method originally due to Lennard-Jones. The velocity spectrum is also determined. Numerical results are given for $n = 6$ and for the two temperatures, $T = 10^{6_0}$ K (Case I) and $T = 1.5 \times 10^{6_0}$ K (Case II). In Case I the escape rate is equal to 7.0×10^{34} proton/s. At 1 au this gives, with the gravitational retardation taken into account, a density of 1.2 cm^{-3} and an average velocity of 200 km/s. In Case II the corresponding numbers are 1.9×10^{35} protons/s, 2.7 cm^{-3}, and 290 km/s. Author

N64-29497* National Aeronautics and Space Administration, Washington, D.C.

HISTORY OF THE LUNAR ATMOSPHERE AND THE POSSIBILITY OF ICE AND ORGANIC COMPOUNDS EXISTING ON THE MOON [ISTORIYA LUNNOY ATMOSFERY I VOZMOZHNOST' PRISUTSTVIYA NA LUNE I'DA I ORGANICHESKIKH SOYEDINENIY]

V. S. Safronov and Ye. L. Ruskol Sep. 1964 16 p refs Transl. into ENGLISH from Vopr. Kosmich., (USSR), v. 9, 1963 p 203–213

(NASA-TT-F-232) OTS: $0.50

The maximum density and probable composition of the ancient lunar atmosphere are determined. It is assumed that the moon had been formed as a cold, solid body with a relative abundance of volatile substances similar to those of the earth. The total amount of volatiles released is assumed to be 100 kg H_2O, 5 kg CO_2, 0.23 kg N_2 per 1 cm^2 of lunar surface. In accordance with the thermal history of the moon heated by radioactive elements, it is supposed that the period of intense degasification of the moon's interior coincided with its melting (some 2.5 to 3 billion years ago), and lasted about 10^9 years. As the atmosphere accumulated, its escape rate increased; when degasification ceased, the density of the atmosphere diminished to its present value. Author

N64-29512* National Aeronautics and Space Administration, Washington, D.C.
PRECISE DETERMINATION OF THE SOURCE FUNCTION OF A FACULA (K VOPROSU O TOCHNOSTI OPREDELENIYA FUNKTSII ISTOCHNIKA FAKELA)
V. D. Kuz'minykh and N. I. Kozhevnikov Sep. 1964 10 p refs Transl. into ENGLISH from Vestn. Moscow. Univ., Ser. III Fiz., Astronomiya, no. 2, 1964 p 52–55
(NASA-TT-F-235) OTS: $0.50

The effect of errors in observations of the facula–photosphere contrast on the accuracy of the determination of the source function of the facula is discussed. Observed discrepancies in values of the facular temperatures as reported by different authors are partially accounted for in terms of observational errors. Author

N64-29560 Naval Research Lab., Washington, D.C.
RADIO ASTRONOMICAL OBSERVATIONS OF VENUS WITH HIGH RESOLVING POWER (RADIOASTRONOMICHESKIE NABLYUDENIYA VENERY S VYSOKOI RAZRESHAYUSHCHEI SPOSOBNOST'YU)
D. V. Korol'kov, Yu. N. Pariyskiy, G. M. Timofeeva, and S. E. Khaikin 8 May 1963 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 149, no. 1, 1963 p 65–67
(NRL-TRANS-936; AD-602904)

The purpose of these investigations was to evaluate the nature of the distribution of radio brightness, by using high resolving power and high precision of the coordinate measurements with a variable profile antenna. The results of measurements of the effective dimensions of Venus are shown. An attempt to determine the phase variations of radio temperature with displacement of the center of gravity of radio emission led to a negative result. The observations agree best with the model of a hot surface and a cold atmosphere. Author

N64-29577 New Mexico State U., University Park Research Center
PLANETARY AND LUNAR RESEARCH IN THE PHOTOGRAPHIC INFRARED, VISIBLE AND ULTRAVIOLET Final Report, 1 Apr. 1961–31 Mar. 1964
Clyde W. Tombaugh Jul. 1964 11 p refs
(Grant DA-ARO(D)-31-124-G41)
(FR-7; AD-443063)

The markings and phenomena that are observable on the disks of Venus, Mars, and Jupiter vary from day to day, and in some features, from hour to hour. A vigorous daily patrol of photographic observations was conducted using a 12-in. Fecker reflecting telescope. Spectroscopic plates with a wide range of color sensitivities and degrees of contrast were used, as well as about a dozen different color filters to isolate photographs to particular spectral regions. The photographs of Venus were taken predominantly in ultraviolet and blue light; almost invariably, the disk of Venus is featureless in the longer wavelengths. For Mars, photographs were taken in ultraviolet, blue, green, and red in rapid succession, in order to compare the same Martian region in the different wavelengths. The photographs of Jupiter were taken in blue, green, and red light, since the appearance of the planet is quite different in the three wavelengths; the irregular drift of the marking implies some vertical movement in Jupiter's atmospheric circulation. Observations of Saturn and of sections of the Moon were also made. D.S.G.

N64-29589 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
STELLAR ASTRONOMY
V. Zonn and K. Rudnitskiy 14 Aug. 1963 8 p Transl. into ENGLISH from the book "Zvezdnaya Astronomiya" Izd. Inostrannoy Lit., 1959 p 131–135
(FTD-TT-63-793/1+2; AD-420660)

An analysis of the theory of selective interstellar absorption and of its uses in determining the distances of remote stars is presented. The method consists in observing a certain star in two zones of the spectrum with corresponding wavelengths. Knowing that diffusion and absorption in interstellar matter depend upon wavelength, and assuming that the optical properties of interstellar matter are identical for various directions and various distances, an absorption value is obtained within limits ranging from zero to the distance of the observed object. A formula is derived for determining the distance of a given star from its absolute magnitude in this photometric system. M.P.G.

N64-29597 American Meteorological Society, Boston, Mass.
PRELIMINARY RESULTS OF OBSERVATIONS OF MARS [PREDVARITEL'NYE REZUL'TATY NABLIUDENII MARSA]
N. P. Barabashov Bedford, Mass., AFCRL, Feb. 1964 9 p Transl. into ENGLISH from Vestn. Akad. Nauk SSSR (Moscow), no. 5, 1957 p 34–36
(Contract AF 19(628)-3880)
(T-R-426 ; AD-602193)

Coordinated observations of Mars were conducted by various observatories throughout the U.S.S.R. for 5 months during the 1956 opposition. All observers noted that the Mars atmosphere was not transparent but was filled with a fog, which interfered with the study of surface features. Considerable changes from past observations were noted, however, in the contrast between the seas and the continents, the appearance and brightness of the southern polar cap and the polar fringe, and the brightness variations of the same land areas with time. The observational data acquired are being processed more fully to get a more accurate picture of the physical conditions on Mars. M.P.G.

N64-29945 Royal Observatory, Edinburgh (Gt. Brit.)
REPORT OF THE ASTRONOMER ROYAL FOR SCOTLAND FOR THE YEAR ENDING 31st MARCH 1964
H. A. Bruck 31 Mar. 1964 19 p refs

The present status of the Royal Observatory, in regard to instrumentation and observations, is presented for the following areas: (1) stellar astronomy and astrophysics; (2) astronomical instrumentation, per se; (3) space research—rocket and satellite astronomy and artificial satellite tracking; and (4) seismology. I.v.L.

N64-30015 California Inst. of Tech., Pasadena Owens Valley Radio Observatory

A DISCUSSION OF GALAXIES IDENTIFIED WITH RADIO SOURCES

Thomas A. Matthews, William W. Morgan (Chicago U.), and Maarten Schmidt 1964 36 p refs

(AD-442604)

A description is given of the optical forms of the identified extragalactic radio sources for which satisfactory plate material is available. These forms fall into two general categories—"weak" sources, having luminosities ranging between 10^{38} to 10^{40} ergs/sec radiated power; and "strong" sources, having luminosities greater than 10^{40} ergs/sec. The spiral galaxies observed to be radio sources are in the "weak" source category. The most commonly encountered optical forms of the identified extragalactic radio sources are galaxies having elliptical inner regions surrounded by an extended envelope (the "D-systems" of Morgan's classification); all of the D-galaxies occur in the "strong" radio-source category. These D-galaxy radio sources frequently have double or multiple nuclei.

Author

N64-30016 California Inst. of Tech., Pasadena Owens Valley Radio Observatory

A COMPILATION OF RADIO SOURCE FLUX DENSITIES

Kenneth I. Kellermann 1964 28 p refs Publications of the Owens Valley Radio Obs., vol. I, no. I

(AD-442603)

The following information is presented in tabular form for 242 galactic and extragalactic radio sources: name of source, spectral classification, the frequency at which the measurements were made, measured flux density, computed intercept at 400 mc/s, and the spectral index.

P.V.E.

06 AUXILIARY SYSTEMS

Includes fuel cells and solar cells; gas turbines; hydraulic, pneumatic and electrical control systems and actuators; and inverters. *For primary propulsion systems see*: 27 Propulsion. *For related information see*: 08 Communications; 09 Electronics; 10 Facilities, Research and Support; 15 Instrumentation and Photography; and 22 Navigation and Guidance.

N64-29152* Pennsylvania U., Philadelphia Power Information Center

PROCEEDINGS OF THE FOURTH PHOTOVOLTAIC SPECIALISTS CONFERENCE. VOLUME I: RADIATION EFFECTS ON SOLAR CELLS AND PHOTOVOLTAIC DEVICES

Aug. 1964 458 p refs Conf. Held at NASA. Lewis Res. Center, Cleveland, 2 Jun. 1964

(Contract NASr-191)

(NASA-CR-58680; PIC-SOL-209/5) OTS: $23.50ph

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3. LOW-ENERGY PROTON BOMBARDMENT OF SILICON CELLS J. J. Wysocki (RCA) 13 p (See N64-29155 21-06)

4. RESULTS OF LOW-ENERGY PROTON IRRADIATIONS OF SOLAR CELLS E. A. Lodi (Lockheed Missiles and Space Co.) 23 p refs (See N64-29156 21-06)

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7. THE ELECTRICAL CHARACTERISTICS OF IRRADIATED SILICON SOLAR CELLS AS A FUNCTION OF TEMPERATURE B. T. Cunningham (NASA. Goddard Space Flight Center) 45 p refs (See N64-29159 21-06)

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9. EFFECTS OF SHIELDING ON ELECTRON DAMAGE TO SOLAR CELLS F. J. Campbell (Naval Res. Lab.) 16 p refs (See N64-29161 21-06)

10. HIGH-ENERGY RADIATION AND SOLAR CELL SHIELDS G. A. Haynes (NASA. Langley Res. Center) 14 p (See N64-29162 21-06)

11. CURRENT STATUS OF DRIFT FIELD SOLAR CELLS P. H. Fang (NASA. Goddard Space Flight Center) 12 p refs (See N64-29163 21-06)

12. SOLAR CELLS PRODUCED BY ION IMPLANTATION DOPING W. J. King (Ion Physics Corp.) 24 p refs (See N64-29164 21-06)

13. PHOTOVOLTAIC EFFECT AND SURFACE STATES ON SILICON-METAL INTERFACES G. Rupprecht (Tyco Labs., Inc.) 22 p (See N64-29165 21-06)

14. SINGLE CRYSTAL GALLIUM PHOSPHIDE SOLAR CELLS A. S. Epstein (Monsanto Chem. Co.) 21 p refs (See N64-29166 21-06)

15. EFFECT OF THICKNESS ON SHORT CIRCUIT CURRENT M. Wolf (Textron Electron., Inc.) 18 p refs (See N64-29167 21-06)

16. SOLAR CELL PERFORMANCE AT HIGH TEMPERATURES J. D. Broder (NASA. Lewis Res. Center) 15 p ref (See N64-29168 21-06)

17. EFFECT OF ANTIREFLECTION COATINGS AND COVERGLASSES ON SILICON SOLAR CELL PERFORMANCE E. L. Ralph (Textron Electron., Inc.) 17 p refs (See N64-29169 21-06)

18. DESIGN OF OPTICALLY REFLECTIVE ELECTRODES FOR GERMANIUM CELLS J. Werth (General Motors Corp.) 7 p refs (See N64-29170 21-06)

N64-29153* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

RADIATION DAMAGE TO SOLAR CELLS ON RELAY I AND RELAY II

Ramond C. Waddel *In* Penn. U. Proc. of the 4th Photovoltaic Specialists Conf. Vol. I: Radiation Effects on Solar Cells and Photovoltaic Devices Aug. 1964 18 p (See N64-29152 21-06) OTS: $23.50 ph

The results of solar-cell radiation-damage experiments on board the Relay I and Relay II satellites are reported, and the degree of agreement between predictions of radiation damage, based on laboratory damage studies and flux data, and that observed in the spacecraft experiments are indicated. Conclusions drawn from the data of the Relay I and Relay II experiments include the following: (1) Unshielded silicon and gallium arsenide solar cells degrade to 75% initial short-circuit response level in less than 1 day. (2) Shields equivalent to 3 mils of Corning 0211 glass, or greater, extend time to

75% initial response by at least a factor of 100, compared to unshielded cells. (3) Heavily shielded n-p silicon cells last about 10 times as long as similarly shielded p-n cells. (4) Predicted damage to the unshielded silicon cells on Relay I agreed fairly well, in time and amount, with observed data. P.V.E.

N64-29154* Brown U., Providence, R.I.
THE EFFECTS OF LOW ENERGY ELECTRON IRRADIATION ON THE SURFACE PROPERTIES OF SILICON SOLAR CELLS
R. F. Santopietro *In* Penn. U. Proc. of the 4th Photovoltaic Specialists Conf. Vol. I: Radiation Effects on Solar Cells and Photovoltaic Devices Aug. 1964 20 p (See N64-29152 21-06) OTS: $23.50 ph
(Contract DA-49-186-AMC-12(X))

Both p/n and n/p silicon solar cells were irradiated by electrons whose energy was below the threshold for bulk radiation damage. The photovoltaic effect produced by strongly absorbed (0.365μ) and penetrating (1.02μ) light was measured during the course of irradiation. It was found that the surface recombination velocity of the n-type surface decreased, while that of the p-type surface increased with increasing flux. It was also found that as the pressure of the ambient decreased, the surface recombination velocity experienced appreciable changes. The experimentally observed changes were used to predict changes in the output of a solar cell, which could be attributed to radiation-produced surface effects. Author

N64-29155* Radio Corp. of America, Princeton, N.J.
LOW-ENERGY PROTON BOMBARDMENT OF SILICON CELLS
J. J. Wysocki *In* Penn. U. Proc. of the 4th Photovoltaic Specialists Conf. Vol. I: Radiation Effects on Solar Cells and Photovoltaic Devices Aug. 1964 13 p (See N64-29152 21-06) OTS: $23.50 ph
(Contract NAS5-3788)

The current and voltage behavior of silicon cells subjected to low energy (185 Kev to 530 Kev) proton radiation is discussed. The form and energy dependence of current degradation is predicted by the results. Low-energy protons reduce the lifetime in regions close to the junction without reducing collection from the base of the cell. It was found that silicon cells approach the exponential behavior ordinarily found in gallium arsenide cells. P.V.E.

N64-29156* Lockheed Missiles and Space Co., Palo Alto, Calif.
RESULTS OF LOW-ENERGY PROTON IRRADIATIONS OF SOLAR CELLS
E. A. Lodi *In* Penn. U. Proc. of the 4th Photovoltaic Specialists Conf. Vol. I: Radiation Effects on Solar Cells and Photovoltaic Devices Aug. 1964 23 p refs (See N64-29152 21-06) OTS: $23.50 ph

The main purpose of this study was to observe the damage effects produced in silicon and gallium arsenide solar cells by protons in the 100 to 500 kev energy range. The n/p cells exhibited a levelling-off in the degradation of the open-circuit voltage for large time-integrated fluxes of 130-kev protons. At 200 kev the short-circuit current displayed a double reversal in degradation. At 300 kev the degradation rate of the short-circuit current at large time-integrated fluxes was higher than it was for higher energy protons. The experiment also confirmed Wysocki's observation that gallium arsenide solar cells degrade rapidly when irradiated with 200- and 500-kev protons. Also included in this paper is a comparison of the low-energy proton results with previous results obtained using 1-, 3-, and 12-Mev protons. Author

N64-29157* Space Technology Labs., Inc., Redondo Beach, Calif.
THE ENERGY DEPENDENCE OF ELECTRON DAMAGE IN SILICON
R. G. Downing *In* Penn. U. Proc. of the 4th Photovoltaic Specialists Conf. Vol. I: Radiation Effects on Solar Cells and Photovoltaic Devices Aug. 1964 32 p refs (See N64-29152 21-06) OTS: $23.50 ph

A discussion is presented of experiments carried out to obtain statistically significant and accurate quantitative data on the energy dependence of electron radiation damage in silicon; to determine the effect of resistivity on the damage rate and energy; and to obtain data on the energy levels and defect mechanisms responsible for electron radiation damage in silicon. P.V.E.

N64-29158* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
EFFECTS OF IMPURITIES ON RADIATION DAMAGE OF SILICON SOLAR CELLS
Joseph Mandelkorn *In* Penn. U. Proc. of the 4th Photovoltaic Specialists Conf. Vol. I: Radiation Effects on Solar Cells and Photovoltaic Devices Aug. 1964 18 p refs (See N64-29152 21-06) OTS: $23.50 ph

Radiation-damage studies of modified boron-doped cells have led to the conclusion that boron atoms in silicon participate in the creation of recombination centers. Gadolinium atoms were substituted for boron atoms in the base region of n-on-p solar cells in an attempt to substantiate this conclusion. A plot of minority-carrier diffusion-length variation as a function of 1-Mev electron flux for gadolinium-doped cells indicates the following: (1) In the dose region of 4×10^{15} to 1.5×10^{16} electrons/cm^2, vacancies are definitely being generated in the cell material. (2) The rate of introduction of damage is a function of bombardment dose as well as impurity content. From an analysis of the characteristics of the modified cells, it is concluded that impurities influence diffusion-length degradation, carrier removal rate, open-circuit voltage, and junction characteristics of the cells. P.V.E.

N64-29159* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE ELECTRICAL CHARACTERISTICS OF IRRADIATED SILICON SOLAR CELLS AS A FUNCTION OF TEMPERATURE
Brian T. Cunningham *In* Penn. U. Proc. of the 4th Photovoltaic Specialists Conf. Vol. I: Radiation Effects on Solar Cells and Photovoltaic Devices Aug. 1964 45 p refs (See N64-29152 21-06) OTS: $23.50 ph

The electrical characteristics of n/p (less than 1 ohm-cm to a nominal 10 ohm-cm base resistivity) and p/n (1 ohm-cm) silicon solar cells irradiated with 1-Mev electron flux to a level of 10^{16} electrons/cm^2 have been obtained through a temperature range of $-100°$ C to $+125°$ C. The information was obtained using a tungsten light source in conjunction with a 3-cm water filter. Correction techniques are described to convert the spectral and intensity distributions to the air mass zero operating environment. Curves are presented that relate the power, voltage, temperature, and 1-Mev electron flux level in a manner useful to the solar power supply designer. Author

N64-29160* Westinghouse Electric Corp., Pittsburgh, Pa.
RADIATION RESISTANCE OF WEBBED DENDRITIC SOLAR CELLS
R. V. Babcock *In* Penn. U. Proc. of the 4th Photovoltaic Specialists Conf. Vol. I: Radiation Effects on Solar Cells and Photovoltaic Devices Aug. 1964 22 p refs (See N64-29152 21-06) OTS: $23.50 ph

Maximizing the radiation resistance of silicon, webbed dendritic solar cells is discussed. Also discussed is the development of dendritic cells, by conventional diffusion techniques, that show maximum resistance to 2-Mev electrons; the study of various drift-field structures as means of increasing radiation resistance; and the effect of a vacuum environment on radiation-damage rates. P.V.E.

N64-29161* Naval Research Lab., Washington, D.C.
EFFECTS OF SHIELDING ON ELECTRON DAMAGE TO SOLAR CELLS
F. J. Campbell *In* Penn. U. Proc. of the 4th Photovoltaic Specialists Conf. Vol. I: Radiation Effects on Solar Cells and Photovoltaic Devices Aug. 1964 16 p refs (See N64-29152 21-06) OTS: $23.50 ph

A study to determine what effect the darkening of the cover glass, used to protect the solar cells used on the SYNCOM II satellite, had on the solar energy conversion efficiency of the solar-cell assembly is outlined. The study was conducted by irradiating the individual components with 1-Mev electrons and by measuring the individual parameters by various methods. P.V.E.

N64-29162* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HIGH-ENERGY RADIATION AND SOLAR CELL SHIELDS
Gilbert A. Haynes *In* Penn. U. Proc. of the 4th Photovoltaic Specialists Conf. Vol. I: Radiation Effects on Solar Cells and Photovoltaic Devices Aug. 1964 14 p (See N64-29152 21-06) OTS: $23.50 ph

Data covering the effect of electron radiation on the optical transmission of a number of transparent materials that could be used as solar-cell covers are presented. Also given are data that compare the degradation of unshielded solar cells with that of cells shielded with various thicknesses of synthetic fused silica, using 2.4-Mev electrons. Two general conclusions are presented: (1) Sapphire was found to be practically unaffected by radiation in the spectral response region of solar cells. (2) Synthetic fused silica is damaged primarily in ultraviolet transmission, thus making it an excellent material for use as solar-cell covers. P.V.E.

N64-29163* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CURRENT STATUS OF DRIFT FIELD SOLAR CELLS
P. H. Fang *In* Penn. U. Proc. of the 4th Photovoltaic Specialists Conf. Vol. I: Radiation Effects on Solar Cells and Photovoltaic Devices Aug. 1964 12 p refs (See N64-29152 21-06) OTS: $23.50 ph

An attempt to improve the radiation resistance of solar cells through the use of drift-field silicon solar cells is presented. Present knowledge of drift-field solar cells is described, and problems encountered in their use and development are discussed. P.V.E.

N64-29164* Ion Physics Corp., Burlington, Mass.
SOLAR CELLS PRODUCED BY ION IMPLANTATION DOPING
W. J. King *In* Penn. U. Proc. of the 4th Photovoltaic Specialists Conf. Vol. I: Radiation Effects on Solar Cells and Photovoltaic Devices Aug. 1964 24 p refs (See N64-29152 21-06) OTS: $23.50 ph

Fabrication of controlled-junction solar cells by implantation of appropriate doping ions into bulk silicon was demonstrated using a Van de Graaff accelerator. Boron ions of energy 100 Kev to 1.5 Mev (0.35μ to 2.3μ junction depth, respectively) were used to form p-type surface layers, and phosphorus ions of 300 Kev energy (0.51μ junction depth) were used for n-type layers. After being passed through an analyzing magnet to obtain a spectroscopically pure beam, the accelerated ions were scanned by electrostatic deflection plates to obtain uniform irradiation of the samples. Doping concentration could be varied as a function of depth in the crystal by programed rotation of the slices about an axis perpendicular to the beam. In this manner it is possible to arbitrarily insert a drift field in the surface region to study the effect on carrier collection efficiency and radiation damage resistance. Author

N64-29165* Tyco Labs., Inc., Waltham, Mass.
PHOTOVOLTAIC EFFECT AND SURFACE STATES ON SILICON-METAL INTERFACES
G. Rupprecht *In* Penn. U. Proc. of the 4th Photovoltaic Specialists Conf. Vol. I: Radiation Effects on Solar Cells and Photovoltaic Devices Aug. 1964 22 p (See N64-29152 21-06) OTS: $23.50 ph

The photovoltaic effect, which is observed at the interface between a metal and a semiconductor in the presence of a thin oxide interface, can be interpreted as the consequence of the charge transfer characteristic of the thin oxide film, and the effect of surface states at the oxide–semiconductor interface. Since the position of the surface Fermi level F_s is determined, to a large extent, by the surface states, the open circuit voltage V_{oc} is directly related to the surface state structure. Four surface states have been identified: $E_1 = 0.37$ ev and $E_2 = 0.54$ ev above the valence band and $E_3 = 0.52$ ev and $E_4 = 0.28$ ev below the conduction band. Author

N64-29166* Monsanto Chemical Co., St. Louis, Mo. Central Research Dept.
SINGLE CRYSTAL GALLIUM PHOSPHIDE SOLAR CELLS
A. S. Epstein *In* Penn. U. Proc. of the 4th Photovoltaic Specialists Conf. Vol. I: Radiation Effects on Solar Cells and Photovoltaic Devices Aug. 1964 21 p refs (See N64-29152 21-06) OTS: $23.50 ph
(Contract NAS3-2776)

Discussed is an investigation of some optical, electrical, and thermal characteristics of experimental solar cells fabricated from epitaxially grown single-crystal gallium phosphide. Two main types of solar cells resulted from the investigation: (1) an extrinsic cell having its main spectral response at room temperature in a broadband roughly centered at about 0.75 microns; and (2) an intrinsic cell having its principal response at about 0.45 microns. The extrinsic cell is characterized by about half the open-circuit voltage and about three times the short-circuit current density of the intrinsic cell. The short-circuit current density of the intrinsic cell increases with temperature, doubling at about 275° C, whereas the extrinsic cell shows little change in short-circuit current until about 200° C, where it decreases rapidly. At higher temperatures, the intrinsic cell is far superior to the extrinsic cell. P.V.E.

N64-29167* Textron Electronics, Inc., Sylmar, Calif. Heliotek Div.

EFFECT OF THICKNESS ON SHORT CIRCUIT CURRENT

Martin Wolf *In* Penn. U. Proc. of the 4th Photovoltaic Specialists Conf. Vol. I: Radiation Effects on Solar Cells and Photovoltaic Devices Aug. 1964 18 p refs (See N64-29152 21-06) OTS: $23.50 ph

The parameters of present high performance n/p silicon solar cells are such that even small reductions in the thickness of the cells result in noticeable decreases of the short-circuit current due to lower collection efficiency at long wavelengths. Theoretical and experimental results of an investigation into the change of short-circuit current as function of thickness are discussed. This effect is studied in dependence on the spectral distribution of the irradiating light for three commonly used types of light source, as well as on the minority carrier lifetime and mobility in the base region of the solar cell.

Author

N64-29168* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

SOLAR CELL PERFORMANCE AT HIGH TEMPERATURES

Jacob D. Broder *In* Penn. U. Proc. of the 4th Photovoltaic Specialists Conf. Vol. I: Radiation Effects on Solar Cells and Photovoltaic Devices Aug. 1964 15 p ref (See N64-29152 21-06) OTS: $23.50 ph

The temperature behavior of various resistivity, unbombarded and bombarded silicon cells, and unbombarded and bombarded gallium arsenide cells is discussed and compared. Characteristics discussed are the open-circuit voltage, the maximum power output, and the curve power factor that is defined as the maximum power output divided by the product of the short-circuit current and open-circuit voltage. P.V.E.

N64-29169* Textron Electronics, Inc., Sylmar, Calif. Heliotek Div.

EFFECT OF ANTIREFLECTION COATINGS AND COVERGLASSES ON SILICON SOLAR CELL PERFORMANCE

E. L. Ralph *In* Penn. U. Proc. of the 4th Photovoltaic Specialists Conf. Vol. I: Radiation Effects on Solar Cells and Photovoltaic Devices Aug. 1964 17 p refs (See N64-29152 21-06) OTS: $23.50 ph

Experiments have been performed to explore the antireflection characteristics of thin films of silicon monoxide, which have been evaporated on the solar cell surface. The effect of the antireflection coating thickness on cell response as a function of wavelength was determined, and the improvement in cell short-circuit current for air-mass-zero space sunlight was evaluated. Included in this study was the evaluation of the antireflection characteristics after the application of a coverglass with adhesive over the antireflection coating. For comparison, coverglasses were also applied to bare cells with no antireflection coating present. Author

N64-29170* General Motors Corp., Santa Barbara, Calif.

DESIGN OF OPTICALLY REFLECTIVE ELECTRODES FOR GERMANIUM CELLS

John Werth *In* Penn. U. Proc. of the 4th Photovoltaic Specialists Conf. Vol. I: Radiation Effects on Solar Cells and Photovoltaic Devices Aug. 1964 7 p refs (See N64-29152 21-06) OTS: $23.50 ph

Fabrication of a relatively transparent photovoltaic cell backed by an optically reflective (gold) electrode is discussed. The germanium photovoltaic cell is to be powered by a radiating gray body at 400° C. P.V.E.

N64-29171* Borden Chemical Co., Philadelphia, Pa. Central Research Lab.

RESEARCH AND DEVELOPMENT OF SEPARATORS FOR SILVER OXIDE-ZINC AND SILVER OXIDE-CADMIUM CELLS FOR SPACECRAFT APPLICATION Second Quarterly Report, Sep. 27,–Dec. 27, 1963

H. E. Hoyt and H. L. Pfluger 7 Feb. 1964 39 p
(Contract NAS5-3467)
(NASA-CR-56943) OTS: $3.60 ph

Polymers of a wide range of polarity were cast as films and screened as potential separators by tests for conductivity and solubility behavior. Only water soluble polymers showed conductivity in 30% and 40% KOH of the order of cellophane. More narrowly, only those in this category that substantially absorbed the KOH solutions gave conductivity of the order of cellophane. Several modifications of polymers formed homogeneous films that have good conductive and tensile properties. Resistance of films to oxidative action of silver oxide in KOH was studied. Irregular results led to elaboration of this test for the purpose of achieving higher controls. Author

N64-29182* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE ELECTRICAL CHARACTERISTICS OF IRRADIATED SILICON SOLAR CELLS AS A FUNCTION OF TEMPERATURE

Brian T. Cunningham, Robert L. Sharp, and Luther W. Slifer 30 Mar. 1964 45 p refs
(NASA-TM-X-55049; X-636-64-135) OTS: $4.60 ph

The electrical characteristics of n/p (less than one ohm-cm to a nominal 10 ohm-cm base resistivity) and p/n (one ohm-cm) silicon solar cells irradiated with 1 Mev electron flux to a level of 10^{16} electrons/cm^2 have been obtained through a temperature range of −100° C to +125° C. The information was obtained using a tungsten light source in conjunction with a 3-cm water filter. Correction techniques are described to convert the spectral and intensity distributions to the airmass zero operating environment. Curves are presented that relate the power, voltage, temperature, and 1-Mev electron flux level in a manner useful to the solar power supply designer.

Author

N64-29208* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

ANALYSIS AND DESIGN PROCEDURES FOR A FLAT, DIRECT-CONDENSING, CENTRAL FINNED-TUBE RADIATOR

Richard P. Krebs, Henry C. Haller, and Bruce M. Auer Washington, NASA, Sep. 1964 110 p refs
(NASA-TN-D-2474) OTS: $2.50

An analysis of a flat, direct-condensing, central finned-tube radiator that rejects heat from both sides was performed enabling the design of space radiators to meet minimum weight and geometric requirements. Two electronic digital computer programs were developed. The first program is based on a fixed conductance parameter and yields a minimum weight design. The second employs a variable conductance parameter and variable ratio of fin length to tube outside radius. This program can be used for radiator designs that have geometric limitations. Both programs consider a Rankine thermodynamic cycle, vapor and liquid headers, pressure drop in the radiator tubes and headers, meteoroid protection for the tubes and headers, radial temperature drop in the tube wall, and fin and tube radiant interchange in the development of the descriptive equations. Major outputs of the two programs include tube

length, number of tubes, radiator aspect ratio, radiator weight, fin length and thickness, specific-heat-rejection rate, and header geometry. Author

N64-29220* Marquardt Corp., Van Nuys, Calif.
STUDY OF BIOCHEMICAL FUEL CELLS Fifth Quarterly Progress Report, 1 May–31 Jul. 1964
G. E. Ellis [1964] 29 p
(Contract NASw-654)
(NASA-CR-58715; Rept.-25141) OTS: $2.60 ph

Electrochemical energy is being used to degrade human waste, the input of current being controlled with a galvanostat. The human waste had been frozen and thawed (the feces were obtained from a special low-cellulose diet), and was used alone as well as with activated sludge obtained from a municipal sewage treating plant. The purpose of these experiments is to determine whether electrochemical energy can be employed in degrading human waste, either to increase the reaction rates or produce less toxic products than conventional sewage disposal techniques. Author

N64-29314 Lockheed Missiles and Space Co., Sunnyvale, Calif.
SEPARATION AND EJECTION SYSTEMS OF FLIGHT VEHICLES: BIBLIOGRAPHY
Helen M. Abbott, comp. Jul. 1964 52 p refs
(Contract NOw-63-0050-c)
(SB-64-14; Rept.-2-60-64-35; AD-445143)

The references are arranged alphabetically by corporate source. Abstracts are given where possible, but are eliminated in cases that would result in the bibliography becoming classified. Author

N64-29316 AiResearch Mfg. Co., Phoenix, Ariz.
SNAP 50/SPUR POWER SYSTEM Quarterly Technical Progress Report for Period Ending 31 Jul. 1964
18 Aug. 1964 131 p
(Contract AF 33(615)-1551)
(APS-5090-R2; AD-444826)

The ultimate objective of the SPUR program is to develop a nuclear-dynamic space power system capable of supplying 300 kw or more of electrical power, with a design life of 10,000 hours. This report presents the current status of the following major technical-work areas: (1) materials development—mechanical properties of TZM; (2) liquid-potassium bearing tests and analysis; (3) turbomachinery tests and analysis;. (4) tests of a 50-kw liquid-cooled model generator; (5) continued development of the generator stator seal and insulation system; (6) the design and fabrication of the full-scale SPUR generator; (7) continued development of the SPUR generator rotor; (8) tests of the stainless-steel heat-transfer components and the heat-transfer loop; (9) fabrication and test of 200-kw potassium boilers; (10) condenser design and development; and (11) control-system analysis. I.v.L.

N64-29326 Naval Ordnance Lab., Corona, Calif. Research Dept.
CHEMOELECTRIC ENERGY CONVERSION FOR NONAQUEOUS RESERVE BATTERY SYSTEMS Quarterly Report, Apr.–Jun. 1964
R. E. Panzer 15 Aug. 1964 19 p refs
(NAVWEPS-8203; AD-446437)

Progress for the quarter is reported on the following projects: ionic melt electrochemistry; electroreduction of aromatic nitro compounds in liquid ammonia solutions; and ammonia cell exploratory development. Author

N64-29350 Melpar, Inc., Falls Church, Va.
A THIN-PLATE BATTERY Supplement to First Quarterly Report on Molecular Circuit Development, 12 Mar.–12 Jun. 1964
J. Smit, H. H. Titus, and R. T. Foley [1964] 25 p refs
(Contract NOw-64-0568-d)
(QR-1; AD-602395) OTS: $2.00

The purpose of this program is to determine the feasibility of producing a practical high-power output, reserve, primary battery based on a liquid-activated ammonia system. Activity reported was concerned principally with the evaluation of multicell battery performance and the design of a self-contained battery unit. The effect on multicell performance of various battery parameters was ascertained, primarily through a fractional series of experiments. The factors analyzed in this series concerned details of cell fabrication and battery construction. The units of this series were evaluated for the most part on the basis of output voltage. In addition to the factorial series, several low-temperature, exploratory experiments were carried out on two sizes of multicell units. These units were activated at temperatures below −54° C. Results of the statistical analyses indicate that battery performance, internal battery temperature, and pressure are significantly affected by the cathode-matrix ratio. The design of the 150-w, self-contained unit is being carried out in three phases, simultaneously—the design and fabrication of test fixtures capable of handling a 40-square-centimeter-area battery plate, a materials compatibility study, and the self-contained unit design per se. I.v.L.

N64-29353 Space Technology Labs., Inc., Redondo Beach, Calif.
A TECHNIQUE FOR LANDING SITE SELECTION BY EARTH-BASED CONTROL
W. A. Finley Jan. 1963 31 p refs

The report describes the results of a study of the techniques, system dynamics, and component characteristics required to control the landing point of a lunar landing vehicle by an earth-based controller. The controller is presented with a television picture of the landing area from which he selects the desired landing point and designates that point by transmitting an appropriate command to the landing craft. A vehicle-borne guidance system then controls vehicle attitude and thrust magnitude to cause a soft landing to occur at the desired point. System operation results in a soft landing even if no command is received. Author

N64-29360* Thompson Ramo Wooldridge Inc., Cleveland, Ohio Electromechanical Div.
OPTIMIZATION STUDY OF HIGH POWER STATIC INVERTERS AND CONVERTERS Quarterly Report No. 3
R. G. Klimo, E. L. Krejny, A. B. Larsen, R. J. Resch, and J. E. Murray 27 Jul. 1964 282 p
(Contract NAS3-2785)
(NASA-CR-54122) OTS: $18.00 ph

Topics covered in this report include waveform analyses of multistepped and pulse-width-modulated waves; preliminary designs of 10 kw inverters generating power at 400 cps through conventional techniques, and at high frequency using pulse width modulation techniques; a summary of low- and medium-power inverter investigations made before program reorientation; and detailed design analyses of a 3,200-cps inverter. Author

N64-29361* Aeronca Mfg. Corp., Baltimore, Md. Aerospace Div.
[OPTIMAL CONTROL SYNTHESIS] Final Report
31 Jul. 1962 185 p refs
(Contract NASr-25)
(NASA-CR-56798) OTS: $13.00 ph

This report represents an attempt to cover the main themes of the effort at producing an optimal control procedure. The first two chapters concern the developing of understanding of the theory of optimal control. A theory that actually computes switching surfaces is developed in chapter three. Chapter four gives a presentation of the adjoint system approach as a synthesis and investigation technique. Highlighted is the development of a computer procedure that will make the handling of a number of trajectories amenable without undue computing time. A novel approach, taking advantage of the possibility of a steepest descent approach, was developed. Chapter five covers some preliminary thoughts on the procedure by which the approaches in chapter four might be realized in hardware configurations that are expressly designed as control computers. Applications to real plants are discussed in chapter six, with emphasis on these applications to the control of Saturn. In addition, there are three appendixes. These are devoted to outlining the algorithm for computing trajectories, given in order of the algebra required; an outline of the steps of a computer program that will effect this algebra; and statements of this program in FORTRAN language. I.v.L.

N64-29417* Monsanto Research Corp., Everett, Mass. Boston Lab.
DEVELOPMENT OF THE DRY TAPE BATTERY CONCEPT Quarterly Report No. 2, 1 May–1 Aug. 1964
B. A. Gruber, J. J. Byrne, R. Kafesjian, K. W. Klunder, E. A. Mc Elhill et al 16 Sep. 1964 88 p refs
(Contract NAS3-4168)
(NASA-CR-54165; MRB-5006Q2) OTS: $8.10 ph

Research on the development of an operating dry tape unit has continued to be concentrated on improving the performance of cathodic discharge characteristics on static and moving tapes; on evaluating encapsulation materials, techniques, and evaporation rate of encapsulated water and electrolytes; and on designing an operating tape unit. Author

N64-29449 Pratt and Whitney Aircraft, East Hartford, Conn.
LIQUID METAL-HEATED SPACE RADIATOR-MOUNTED THERMIONIC GENERATOR Second Quarterly Report, 1 Oct.–31 Dec. 1963
F. C. Harter [1963] 26 p
(Contract AF 33(657)-11320)
(PWA-2303; AD-429161)

The application of cylindrical thermionic generators heated by a liquid-metal system to space power configurations is being investigated. Procurement of materials for the generator is completed. The fabrication process of the generator is described. Also described is the designing and construction of test systems for the generator. P.V.E.

N64-29484 Oklahoma State U., Stillwater
PROCEEDINGS OF A CONFERENCE ON ENERGY CONVERSION AND STORAGE
Jul. 1964 111 p refs Conf. held 28 Oct. 1963, Stillwater, Okla. Okla. State U.: $5.00

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3. ENERGY STORAGE AS AN INVENTORY CONTROL PROCESS Wolter J. Fabrycky p 35–46 refs (See N64-29487 21-06)
4. A REPORT ON SOME OF THE EXPERIMENTAL WORK ON ENERGY CONVERSION AND STORAGE AT OKLAHOMA STATE UNIVERSITY William L. Hughes p 47-64 (See N64-29488 21-06)
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N64-29485 Oklahoma State U., Stillwater
USES OF ENERGY STORAGE SYSTEMS
William L. Hughes *In its* Proc. of a Conf. on Energy Conversion and Storage p 1–13 (See N64-29484 21-06) Okla. State U.: $5.00

The economic benefit that utility and electric-power companies would derive from practical energy-storage techniques is stressed in this paper. Some possible direct energy-conversion techniques, discussed in a general manner, include magnetohydrodynamic, thermoelectric, thermionic, and fuel-cell schemes. Solar cells, wind generators, and possibly ocean tides are other possibilities. The ultimate purpose of investigating each of these techniques is to devise a system in which the input and output energy rates are independent of each other, so that power facilities can operate at their constant average load, with the excess energy produced during periods of light consumption being stored for periods of peak demand. Also, the role of the university in challenging the minds of electrical-engineering graduate students with such problems, and thus preparing the future technological lifeblood for electrical-power industries, is indicated. M.P.G.

N64-29486 Oklahoma State U., Stillwater
A QUANTITATIVE EVALUATION OF POWER DENSITY AND STORAGE CAPACITY FOR SOLAR AND WIND ENERGY
C. M. Summers *In its* Proc. of a Conf. on Energy Conversion and Storage p 15–33 (See N64-29484 21-06) Okla. State U.: $5.00

Increasing efficiencies of fuel cells that convert and reconvert hydrogen and oxygen fuel and electricity directly makes the age-old dream of utilizing solar energy more feasible. Calculations of the annual mean power-density value, of the efficiency of solar conversion units, and of the storage capacity required show that this method is not economically feasible at present. The same calculations made for wind energy (another form of solar energy) show that wind energy conversion is technically and economically feasible. A comparison of solar-energy and wind-energy power-density data shows that in those months when the sunlight is above average, the wind

energy is below average; therefore, a combination of the two systems might be used to produce a more constant output. M.P.G.

N64-29487 Oklahoma State U., Stillwater
ENERGY STORAGE AS AN INVENTORY PROCESS
Wolter J. Fabrycky *In its* Proc. of a Conf. on Energy Conversion and Storage p 35–46 ref (See N64-29484 21-06) Okla. State U.: $5.00

In present energy supply-storage-demand systems, the system that will incur least cost may be determined by developing the total system-cost function through the addition of investment cost plus shortage cost. This analysis is used as the basis for evaluating an experimental supply-storage-demand system based on electrolysis of water, with subsequent storage of the gases under pressure. The hydrogen in the pressure tanks is released through a pressure reducer to a fuel cell at a rate that is determined by the load demand; the resulting water is recirculated into the pressure electrolysis system. Again, total system cost is the sum of the cost of shortages and the investment cost of the entire system, but the minimum cost point occurs at a specific conversion capacity–storage capacity combination. Some general rules for determining those cases in which the energy storage concept is economically feasible are included. This concept will undoubtedly become more economically attractive with increasing scarcity and cost of fossil fuels, since the storage capability permits the use of solar, wind, tidal, hydro, fission, or fusion energies. M.P.G.

N64-29488 Oklahoma State U., Stillwater
A REPORT ON SOME OF THE EXPERIMENTAL WORK ON ENERGY CONVERSION AND STORAGE AT OKLAHOMA STATE UNIVERSITY
William L. Hughes *In its* Proc. of a Conf. on Energy Conversion and Storage p 47–64 (See N64-29484 21-06) Okla. State U.: $5.00

Experimental approaches to three of the problems of fuel-cell operation are discussed. A possible solution to the first problem, that of raising the H_2 and O_2 molecules to higher reactive energy states, became evident when it was noted that the short-circuit current in a Sen electrolysis cell could be maintained for days when the system was run at pressures of about 50 atm. An approach to the liquid-gas interface problem created by a flate-plate porous electrode system was found by tilting the plates so that the gases rise and stay separated, feeding out through holes at the upper edges of the plates. This configuration also alleviates the problem of membrane rupture due to differential pressure buildup. Preliminary considerations of a magnetohydrodynamic fuel cell that would require neither catalyst nor electrolyte are also discussed. M.P.G.

N64-29489 Oklahoma State U., Stillwater
EXPERIMENTAL WORK TO DATE ON ENERGY CONVERSION AND STORAGE AT OKLAHOMA STATE UNIVERSITY
H. Jack Allison *In its* Proc. of a Conf. on Energy Conversion and Storage p 65–72 (See N64-29484 21-06) Okla. State U.: $5.00

Attempts to increase the efficiency of an energy-storage system that uses high-pressure electrolysis for the production of hydrogen and oxygen gases, with fuel cells for subsequent recombination of the gases to form water and electricity, are reported. Possible factors responsible for the consistently observed increase in electrolysis efficiency with increasing pressure are discussed. Attempts to use ultrasonic agitation to disrupt the cloud of hydroxyl ions that forms in front of the cathode surface and impedes the further formation of hydroxyl ions are reported. Another approach to disrupting this cloud involves pulsing the output of the cell; the transient performance of all the fuel cells tested was found to be several orders of magnitude greater than the steady-state performance. Another encouraging development reported is the commercial development of a fuel cell that works on a non-noble catalyst at standard temperature and pressure, bringing fuel cells much closer to practical economic reality. M.P.G.

N64-29490 Oklahoma State U., Stillwater
ENERGY STORAGE SYSTEM CONCEPTS, ADVANTAGES, LIMITATIONS, AND EFFICIENCIES
H. Jack Allison *In its* Proc. of a Conf. on Energy Conversion and Storage p 73–80 refs (See N64-29484 21-06) Okla. State U.: $5.00

Considered are the advantages, limitations, and efficiencies of two energy-storage concepts—first, storing high energies in high magnetic fields; and second, storing energy by performing electrolysis of water and storing the resulting hydrogen at high pressure. The analysis presented shows that the technological difficulties of maintaining high magnetic fields in storage coils at cryogenic temperatures, when related to the small amount of energy that could be recovered, makes this storage concept unrealistic at present. On the other hand, the electrolysis–hydrogen storage method is well within the state-of-the art, has few moving parts, and can operate at efficiencies of about 60%, despite the energy lost through the use of solid-state converters to provide ac power. M.P.G.

N64-29491 Oklahoma State U., Stillwater
THE BASIC TECHNICAL PROBLEMS ASSOCIATED WITH A SOLAR TO ELECTRICAL SYSTEM WITH INTERMEDIATE ENERGY STORAGE
C. M. Summers *In its* Proc. of a Conf. on Energy Conversion and Storage p 89–95 (See N64-29484 21-06) Okla. State U.: $5.00

The five basic groups of components for a proposed pilot-plant operation, based on solar to electrical energy conversion with intermediate energy storage, are listed. The technological problems associated with each group include these: (1) the solar (in this case, wind energy) to electrical energy transducer; (2) the electrolysis and storage system; (3) the fuel cell; (4) the solid-state inversion system; and (5) reconversion components to convert excess electrical energy to a fuel storage. M.P.G.

N64-29514* IIT Research Inst., Chicago, Ill. Technology Center
INVESTIGATION RELATING TO THE DEVELOPMENT OF CADMIUM TELLURIDE ENERGY CONVERTERS Final Report, Jul. 10, 1962–Aug. 31, 1963
B. J. Robinson, M. Scott, O. G. Brandt, A. R. Moser, and A. P. van den Heuvel 30 Sep. 1963 18 p refs
(Contract NASw-455)
(NASA-CR-56836; IITRI-1220) OTS: $1.60 ph

Some CdTe was cast in the form of a thin, slightly curved layer. It was found to be both single crystal and to have electrical characteristics superior to any material previously reported in the literature. A new vertical zone refining procedure was developed, as a result of attempts to reproduce this layer, which is better than the previously employed methods in ultimate purity attainable, simplicity, and speed. Considerable

delay in developing this process was encountered due to persistent devitrification and consequent breakage of the quartz tubes containing the CdTe. However, vertical zone refining was successfully carried out on several boules. Author

N64-29521* Electro-Optical Systems, Inc., Pasadena, Calif.
HYDROGEN-OXYGEN ELECTROLYTIC REGENERATIVE FUEL CELLS, JANUARY 18–JUNE 30, 1964
Harvey Frank 26 Jul. 1964 86 p
(Contract NAS3-2781)
(NASA-CR-58583; EOS-4110-2Q-1) OTS: $8.10 ph

A six-cell regenerative fuel cell was built and tested. Operational parameters and cell design features affecting cell performance were evaluated. Thirteen series of runs were conducted with varying degrees of success. In general, electrochemical performance was satisfactory. Mechanical design problems, however, eventually caused the termination of each test series. The last test series resulted in a complete failure of the fuel cell structure due to an internal combustion and fire. Results of the test program, an analysis of these results, and conclusions are presented herein. Author

N64-29574* General Electric Co., Philadelphia, Pa. Missile and Space Div.
STUDY ON APPLICATION OF NUCLEAR ELECTRICAL POWER TO MANNED ORBITING SPACE STATIONS Final Summary Report
7 Sep. 1964 79 p refs
(Contract NAS3-4160)
(NASA-CR-54161; Rept.-64SD913) OTS: $7.60 ph

Studies on the application of nuclear-electric power to manned orbiting space stations have been completed and are summarized. Fully surrounding, 4π reactor shields were examined. An arrangement that allows for unrestricted access to the power-conversion system and the retention of greater than 80% of the shield at plant replacement is the major design feature. Techniques for in-space replacement and for old powerplant disposal were examined. The 35-kwe SNAP-8 system, under current development, and its reliability goals and operational requirements are described and compared to the requirements of a manned space station. Variations in the system design, employing the same technology and similar components, are presented to indicate how the SNAP-8 reactor and its components can be used to fulfill these requirements. Results of the studies show that it will be possible to adapt nuclear systems, currently under development, to provide the high degree of reliability necessary for this manned mission. Initial system launch weights, including shielding, are comparable to those of solar photovoltaic systems when the fuel required to compensate for solar array drag and to maintain orientation is considered. I.v.L.

N64-29575* Electro-Optical Systems, Inc., Pasadena, Calif.
NUCLEAR-ELECTRIC POWER REQUIREMENTS FOR ELECTRIC ROCKETS
Ronald S. H. Toms, Rolf D. Buhler, George R. Brewer, (Hughes Res. Labs.) Robert G. Jahn, (Princeton U.) Richard R. John (Avco Corp.) et al [1964 47 p refs Presented at the 3rd Biennial Aerospace Power Systems Conf., Philadelphia, 1–4 Sep. 1964
(AIAA Paper-64-765) AIAA: $0.50 members, $1.00 nonmembers

This paper summarizes the work of many contributors in describing the nature of the load that will be seen by a nuclear-electric power supply when it is integrated, with an electric thruster system, into a nuclear-electric rocket as primary propulsion for space missions. Chief current candidate thruster types are described, with emphasis on the arcjet, the contact ion engine, the bombardment ion engine, and the pulsed plasma engine. Author

N64-29579 National Cash Register Co., Dayton, Ohio Research Div.
INVESTIGATION OF CHEMICALLY SPRAYED THIN-FILM PHOTOVOLTAIC CELLS Quarterly Report, 15 May–14 Aug. 1964
R. R. Chamberlin and J. S. Skarman [1964] 29 p refs
(Contract AF 33(615)-1578)
(QR-1; AD-446736)

The current program status includes these results: (1) Heating by the "hot roller" technique, as a method for achieving the desirable foil (substrate) surface, was found to fulfill all requirements for an alloying system that is compatible with continuous production techniques, and all future cells will use substrates prepared by this technique. (2) Changes in the basic chemical composition of the spray solution, used in the deposition of the n-type CdS-base film, have resulted in solar cells with much higher open-circuit voltages. The higher voltage solar cell shows promise of greater conversion efficiency and also of greater temperature stability. (3) Preliminary optimization efforts on the Cu_xS_y junction, as applied to the high-voltage-type CdS, have indicated that the post-deposition heat-treatment required is not the same as was previously determined for the more conventional-type CdS solar cell. (4) The highest efficiency that has been achieved in a 1-cm^2 cell is about 2.0%, and that in a 1-$in.^2$ cell is about 0.9%. (5) Preliminary basic research has been conducted to building a foundation of understanding of the CdS solar cell, so that the future or ultimate capability can be more quickly realized. I.v.L.

N64-29585 Electrochimica Corp., Menlo Park, Calif. Research and Development Lab.
DIRECT AMMONIA-AIR FUEL CELL Quarterly Report No. 3, 1 Jan.–1 Apr. 1964
[1964] 50 p refs
(Contract DA-36-039-AMC-03245(E))
(Rept.-3; AD-445865)

Performance studies were conducted extensively on direct ammonia fuel cells. Two new types of catalysts were studied and compared with platinum black. Gasketing problems and a new cell structure are discussed. Further improvements in techniques involved in making a complete material balance are described. Results of studies of formation of traces of nitrates and nitrites by chemical side reaction are given and discussed. Kinetics of the anodic oxidation of ammonia were analyzed theoretically and experimentally investigated in a special apparatus to determine the nature of the controlling step. Results indicate that oxidation of the intermediate metal-amine adsorbed species is rate controlling. Theoretical and practical considerations of the water balance and transport problems are discussed. Author

N64-29602* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE STATE OF THE ART IN SOLAR CELL ARRAYS FOR SPACE ELECTRICAL POWER
William Cherry and J. A. Zoutendyk (Calif. Inst. of Tech.) [1964] 38 p refs
(AIAA Paper-64-738) AIAA: $0.50 members, $1.00 nonmembers

Improvements have increased silicon solar cell efficiencies from roughly 5% to 11% in space sunlight. Material improvements have been made in silicon, which have enhanced the

resistance of silicon solar cells to particle radiation. The methods used to connect cells into modules as a building block for constructing large arrays have been improved also. New methods in the soldering of cells into modules have decreased the degradation of the cells due to handling and soldering. In addition, the successful fabrication of cells into modules has made possible the matching of cells by modules rather than by single cells. The methods used to mount the modules to the supporting structure have been improved by using better techniques and bonding agents. With these advances, sun-oriented arrays have been built that approach 10 w/ft^2 and 10 w/lb when operated in near-earth space (with no particle radiation damage). Author

N64-29626 Bendix Corp., South Bend, Ind. Bendix Products Aerospace Div.
LUNAR LANDING DYNAMICS SYSTEMS INVESTIGATION Mid-Term Report
18 Jun. 1964 109 p refs
(MM-64-4)

CONTENTS:

1. AN APPROACH TO A PARAMETRIC STUDY OF LUNAR-LANDING SYSTEMS Raymond Cohen 10 p (See N64-29627 21-06)

2. GENERAL FEATURES OF LANDING GEAR SYSTEMS FOR WIDELY DIFFERENT DESIGN SPECIFICATION LIMITS R. J. Black 19 p (See N64-29628 21-06)

3. A DIGITAL COMPUTER PROGRAM FOR THE PREDICTION OF LUNAR TOUCHDOWN PHENOMENA J. L. Gibson 10 p (See N64-29629 21-10)

4. UNSYMMETRICAL LANDING GEAR SYSTEMS R. J. Black 27 p ref (See N64-29630 21-06)

5. AN APPROXIMATE SOLUTION OF LUNAR VEHICLE LANDING STABILITY L. H. N. Lee, R. Schoenhals, and F. Kobayashi 13 p (See N64-29631 21-10)

6. EXPERIMENTAL PROCEDURES WITH A DYNAMICALLY SCALED DROP TEST MODEL W. D. Chambers 9 p (See N64-29632 21-10)

7. COMPARISON OF EXPERIMENTAL AND THEORETICAL RESULTS R. J. Black 7 p (See N64-29633 21-10)

8. AN EXPERIMENTAL INVESTIGATION OF NONPLANAR R. J. Black 8 p (See N64-29634 21-10)

N64-29627 Bendix Corp., South Bend, Ind.
AN APPROACH TO A PARAMETRIC STUDY OF LUNAR-LANDING SYSTEMS
Raymond Cohen *In its* Lunar Landing Dyn. Systems Invest. 18 Jun. 1964 10 p (See N64-29626 21-06)

Examples are shown indicating that a parameter study is essential for the establishment of good design procedures. Performance indices are presented that may be computed as a function of system parameters. These parameters are divided into those that are under the control of a landing gear designer and those given to him as specifications. A procedure for a reasonable parameter variation study is presented in the form of a flow diagram. Author

N64-29628 Bendix Corp., South Bend, Ind.
GENERAL FEATURES OF LANDING GEAR SYSTEMS FOR WIDELY DIFFERENT DESIGN SPECIFICATION LIMITS
R. J. Black *In its* Lunar Landing Dyn. Systems Invest. 18 Jun. 1964 19 p (See N64-29626 21-06)

A parameter variation study of landing gear sets to be used on a lunar landing spacecraft is being carried out for two purposes: (1) to determine optimum or near-optimum sets of landing gear parameters for a particular specification set; and (2) to obtain a detailed understanding of parameter effects for a particular landing-gear set. Five specification sets consisting of variations in ground slope and protuberance height were selected. Ground slopes of 5, 15, and 25 degrees, and protuberance height of one-half, 2, and 4 feet were selected. Using initial input data, checkout computer runs were made to ascertain the stability, stroke, and nozzle clearance of the initial design. P.V.E.

N64-29630 Bendix Corp., South Bend, Ind.
UNSYMMETRICAL LANDING GEAR SYSTEMS
R. J. Black *In its* Lunar Landing Dyna. Systems Invest. 18 Jun. 1964 27 p ref (See N64-29626 21-06)

A summary of studies conducted to determine if an unsymmetrical landing-gear system for a lunar-landing vehicle such as LEM would have advantages over a symmetrical design is presented. Based on the results presented, it is concluded that with directional control of the vehicle's velocity vector, an unsymmetrical gear design can be made resulting in substantial weight savings in the landing-gear system. An approximate analysis indicates that the weight savings would be 100 to 200 lb out of a total weight of 660 lb for a gear system designed for 1-meter-high discontinuities, or 100 to 200 lb out of 485 lb for a system designed for 10-cm discontinuities. An unsymmetrical landing-gear design could tolerate more severe impact conditions than an equivalent symmetrical landing-gear system having the same weight. P.V.E.

N64-29691* Atomics International, Canoga Park, Calif.
THE EFFECTS OF RADIATION ON NICKEL-CADMIUM BATTERY ELECTRODES, II Mid-Point Report, 13 Mar.–13 Jun. 1964
G. R. Argue, H. L. Recht, W. A. Mc Collum, and D. E. Mc Kenzie 29 Jul. 1964 27 p refs
(JPL-950514)
(NASA-CR-58570; AI-64-161) OTS: $2.60 ph

A total average gamma dose of 9.0 × 10^7 rads (H_2O) caused a cadmium electrode, being cycled near 75 percent of full charge, to lose about 15 percent of its original capacity. The same dose caused essentially no loss in capacity of a fully charged cadmium electrode. A blank cell run at 45° C (the temperature inside the Co-60 source) showed no loss of capacity, indicating that this is not a temperature effect. Experiments were carried out to study the radiolysis of aqueous KOH solutions at concentrations from 0.5 percent to 40 percent. Hydrogen and oxygen were evolved in a ratio of approximately 2:1 by volume at a concentration of 0.5-percent KOH. At concentrations from 10 percent to 40 percent, the amounts evolved of both gases were considerably reduced, with the oxygen being undetected in most samples. Radiolysis of 30-percent KOH containing a portion of a nickel electrode produced relatively large amounts of oxygen, whereas only hydrogen was evolved during the irradiation of a similar solution containing a portion of a cadmium electrode. A mechanism is proposed to explain these results. Author

N64-29695* Electro-Optical Systems, Inc., Pasadena, Calif.
RESEARCH AND DEVELOPMENT TECHNIQUES FOR FABRICATION OF LIGHTWEIGHT SOLAR CONCENTRATORS Final Report, 1 Nov. 1961–6 Oct. 1962
M. A. Pichel 5 Nov. 1962 158 p
(Contract NAS7-86)
(NASA-CR-58579; EOS-2100) OTS: $11.50 ph

Small-scale studies lead to improved structural design of one-piece concentrators. Appropriate tooling was designed and fabricated to permit the adaptation of the new structural

approaches to the fabrication of 5-ft-diam mirrors. The new mirror design and tooling concepts were used in the fabrication of several 5-ft-diam concentrators, and the results of the studies of physical properties and coatings were used in establishing the plating and coating procedures. The program has resulted in an improved backing structure design for the large concentrators. The studies of physical properties have defined trends in the effects produced by plating parameters on the strength and modules of elasticity of the electroforms. Plating procedures have been improved and formalized, and vacuum coating approaches have been systematized. Author

N64-29708* Clevite Corp., Cleveland, Ohio Electronic Research Div.
STUDY OF THIN FILM LARGE AREA PHOTOVOLTAIC SOLAR ENERGY CONVERTER Quarterly Report No. 3, 1 Apr.–30 Jun. 1964
Warren J. Deshotels and Frank Augustine 24 Jul. 1964 34 p refs
(Contract NAS3-2795)
(NASA-CR-54145) OTS: $3.60 ph

Sixty-one evaporations were completed. The evaporator was improved and made more efficient by the addition of heat shields and the elimination of the quartz cloth plug. These changes resulted in greater uniformity of electrical properties and better adherence of the film to the substrates. Small but important changes introduced in the fabrication process have resulted in a significant increase in average efficiency from 2.0% to 2.6%. Considerable progress was made toward solving the curling problem associated with the difference in thermal expansion between CdS and H-Film. Most of the improvement centers around better embossing techniques. Lamination of the cells between sheets of mylar results in flat cells. Author

N64-29727* General Electric Co., Philadelphia, Pa. Missile and Space Div.
STUDY ON APPLICATION OF NUCLEAR ELECTRICAL POWER TO MANNED ORBITING SPACE STATIONS. PHASE III: SNAP-8 EVALUATION AND DEVELOPMENT PROGRAM RECOMMENDATIONS Third Topical Report
B. J. Tharpe and Edward Ray 7 Sep. 1964 133 p refs
(Contract NAS3-4160)
(NASA-CR-54160; Rept.-64SD914)

Factors studied in this report include the design considerations for replacement powerplants, methods of assuring system restart capability, instrumentation and controls for man-rating, and SNAP-8 growth potential. In addition, a comparison of solar photovoltaic and SNAP-8 power systems, at a power level of 40 kw, for a large 3-spoke station is presented, and recommendations are made for providing information essential to man-rating from the present SNAP-8 development program. I.v.L.

N64-29830 Army Missile Command, Huntsville, Ala.
ENVIRONMENTAL TESTING OF SQUIBS
Phillip H. Garrard 27 May 1946 25 p
(RT-TR-64-7; AD-602287)

The results of environmental testing of 135 piston actuator, dimple actuator, and match type squibs are presented. Tests conducted were high and low temperature, drop, shock, vibration, altitude, no-fire, humidity, autoignition, and temperature shock. Two failures occurred during the program: the first was the breakage of a lead wire under vibration, and the second was the failure of a closure at firing. Author

N64-29838 Air Force Systems Command, Wright-Patterson AFB, Ohio Aerospace Medical Research Labs.
OXYGEN-NITROGEN INDICATOR-CONTROLLER AND SPACE CABIN OUTBOARD LEAK SIMULATOR
W. F. Mickelson and W. D. Hypes Jun. 1964 15 p refs
(AMRL-TDR-64-25; AD-604528)

The evaluation of a compact electrical–mechanical device for controlling the oxygen–nitrogen concentration of the atmosphere within an aerospace vehicle cabin simulator during a 2-man, 3-day test is described. Also described is a device used during the evaluation to program various rates of leakage of the atmosphere from the simulator so the response of the controller could be checked periodically. Data obtained reveal a capability for automatically controlling the oxygen-filler gas concentration in an aerospace vehicle cabin simulator over varying ranges of total cabin pressures. Author

N64-29914 Franklin Inst., Philadelphia, Pa.
CATALYTIC COMBUSTION HEAT SOURCES FOR THERMAL ENERGY CONVERTERS Final Progress Report, 29 Mar. 1963–15 May 1964
Mullapudi M. Reddi and Robert A. Baker 1 Aug. 1962 39 p refs
(Contract DA-36-039-AMC-02177(E))
(F-B2088; AD-444953)

Investigations leading to the development of a catalytic burner using leaded gasoline as a fuel for use with thermoelectric generators are reported. Details of an experimental catalytic reaction are given along with catalyst evaluation results. Two classes of catalysts were selected for study. These were copper oxide and vanadium pentoxide-based materials. The former possessed relatively low initiation temperatures for gasoline oxidation and had the potential for oxidizing a wide range of hydrocarbon types and carbon monoxide. The latter required higher initiation temperatures, were less effective for carbon monoxide, but offered greater lead deactivation potential. Author

N64-29936 Malaker Labs., Inc., High Bridge, N.J.
INVESTIGATION OF GAS LIQUEFIERS FOR SPACE OPERATION Technical Documentary Report, Oct. 1962–May 1963
J. G. Daunt, R. A. Rossi, E. G. Jakobsson, and S. F. Malaker Wright-Patterson AFB, Ohio, AF Aero-Propulsion Lab., Aug. 1963 164 p refs
(Contract AF 33(657)-10133)
(ASD-TDR-63-775; AD-604739)

Thermodynamic cycles are described and compared that are suitable for use in space for the liquefaction and reliquefaction of helium, hydrogen, nitrogen, fluorine, and oxygen at rates from 1 lb per day to 1,000 lb per day. The report is subdivided into nine sections, including ranges, efficiencies, and systems of liquefaction and reliquefaction; Stirling cycle systems; Taconis cycle systems; compressors, motors, expanders, and space environment and component compatibility and design. A.W.

N64-29973 Sperry Phoenix Co., Ariz.
DIGITAL ADAPTIVE FLIGHT CONTROL SYSTEM, PHASE II Final Report, May 1962–Sep. 1963
R. E. Andeen and P. P. Shipley Wright-Patterson AFB, Ohio. AF Flight Dyn. Lab., May 1964 99 p refs
(Contract AF 33(657)-8658)
(ASD-TDR-63-854; AD-604420)

An investigation was made to determine if the dynamics of an aerospace vehicle might be identified more readily if represented in some other form than a z-transform. An analysis

This note shows how partial fractions may be used to and simulation performed indicate that a representation in terms of linear bandpass filters is preferable. An investigation was made of an implicit response matching technique applicable to both identification and synthesis, which form the bases for self-adaptive control. In a digital simulation the implicit technique was able to simultaneously identify five parameters of a typical aerospace vehicle within 2 seconds without noise, and within 5 seconds with 30% noise. Author

N64-29975 General Electric Co., Johnson City, N.Y.
ANALYTICAL INVESTIGATION OF CONTROL REQUIREMENTS FOR HIGH SPEED LOW ALTITUDE PENETRATION
Final Report
R. P. Quinlivan, G. Tye, and H. H. Westerholt Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Jun. 1964 33 p refs
(Contract AF 33(657)-11318)
(FDL-TDR-64-104; AD-604684)

A moderately sophisticated simulation of all elements of the automatic control of an aircraft in pitch was used. The control techniques are a departure in concept from those popularly used to date. Evaluation of the simulated system performance was the chief means of system analysis. The evaluations were made using four terrain samples, and included 17 combinations of aircraft configuration and flight conditions, gust disturbances, and radar errors. A limited evaluation of manual control was made. Author

N64-29983 Smith (A.O.) Corp., Milwaukee, Wis. Long Range Research Lab.
SMALL AUXILIARY POWER SYSTEMS FOR SHELTERS
Francis W. Lauck, Vern D. Overbye, and David D. Hart May 1964 162 p refs
(Contract OCD-OS-62-282)
(AD-603227)

Conventional and unconventional methods of storage of engine generator sets and a fuel supply are discussed. Methods for removal of waste heat and noxious fumes and control of noise and vibration are discussed to facilitate installation of engine-generator sets in shelters. Several means of utilizing engine waste heat for other shelter activities are presented and discussed; also means of utilizing more conventional heating devices are considered. Installation, maintenance, and repair procedures as well as operating instructions are discussed in detail. Finally, a thermodynamic analysis and preliminary design of two Rankine-cycle power generators utilizing a turbine and reciprocating engine, respectively, are included. Author

N64-29986 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
RADIOELECTRONICS OF GUIDED MISSILES
P. T. Astasenkov 10 Jul. 1964 218 p refs Transl. into ENGLISH of the book "Radioelektronika Rizenychstrel, vol. 18" Praha, Nase Votsko, 1962
(FTD-TT-63-772/1+2+3+4; AD-603396)

This book is of particular value to those who desire a more thorough study of the fundamentals of the radioelectronic instruments employed in reaction ballistic missiles and who desire to form their own independent opinion with regard to further developments in the near future. It consists of the following: Chapter I, "Reaction Ballistic Missiles, a New Type of Weapon"; Chapter II, "Automatic Devices Used for Missile Guidance"; Chapter III, "Radioelectronic Equipment in Command Guidance Systems"; Chapter IV, "Missile Beam-Rider Guidance"; Chapter V, "Radio-Navigation Techniques in Missile Guidance"; Chapter VI, "Homing Fuses"; Chapter VII, "Proximity Fuses"; Chapter VIII, "Radioelectronics and the Design of New Types of Guided Missiles"; Chapter IX, "Radioelectronics and the Problem of Defending against Guided Rocket Missiles"; and Chapter X, "Radioelectronics and Defenses against Guided Missiles". I.v.L.

N64-30013 Air Force Systems Command, Wright-Patterson AFB, Ohio AF Aero Propulsion Lab.
CHARACTERISTICS OF SEPARATORS FOR ALKALINE SILVER OXIDE ZINC SECONDARY BATTERIES. SCREENING METHODS
J. E. Cooper and Arthur Fleischer, ed. [1964] 156 p refs
(Contracts NAS5-2860; AF 33(615)-1236; AF 33(657)-8689; AF 33(657)-8943; AF 33(657)-10643)

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N64-30042 Naval Research Lab., Washington, D.C. Chemistry Div.
THE LEAD CALCIUM BATTERY. PART 4: COMPARISON OF LEAD CALCIUM AND LEAD ANTIMONY CELLS IN FLOAT
Jeanne Burbank 10 Jun. 1964 10 p refs
(NRL-6078; AD-602378) OTS: $1.00

Four small portable lead acid cells were tested in a float cycle routine. Three of these cells had lead calcium alloy, and one had lead antimony alloy in the positive grids. Otherwise the cells were identical. All cells had lead calcium negatives. Cells with the lead calcium alloy positive grids failed early in the test accompanied by excessive softening of the positive active material, as they invariably did in the earlier tests in this series of investigations. The presence of antimony in the positive grid caused depolarization of the positive plate in the

floating cell, as well as the usual depolarization of the negative on overcharge. The active material of the antimonial cell remained firm for the duration of the tests, and this cell had not failed at the conclusion of the investigation. X-ray diffraction showed that the antimonial cell's positive plate contained more α PbO_2 than the calcium cells, both before and after testing. Author

N64-30047* Alfred U., N.Y.
FUEL CELL RESEARCH: AN INVESTIGATION OF NON-STEADY-STATE OPERATION Second Semiannual Report
T. J. Gray, A. A. Schneider, and R. B. Rozelle 1 Aug. 1964 29 p refs
(Grant NsG-384)
(NASA-CR-54163) OTS: $2.60 ph

This report on fuel cell research includes the following activities: (1) Preliminary information was obtained from an investigation of nonsteady fuel-cell operation, indicating an improvement in the operational capability of a hydrogen–oxygen fuel cell under pulsed loading conditions. In addition to the direct operation of a complete fuel cell under pulsed loading conditions, a detailed investigation of the individual electrode reactions was initiated using galvanostatic measurements. (2) A galvanostat was developed simultaneously with the development of the pulse loading equipment for the purpose of affording precision galvanostatic measurements, under a very wide current range, with a high degree of precision. I.v.L.

N64-30062 General Dynamics/Fort Worth, Tex. Nuclear Aerospace Research Facility
EVALUATION OF RADIATION ENVIRONMENT AND SHIELD DESIGN PARAMETERS FOR THE SNAP-10A/AGENA-D AND SNAP-2/AGENA-D VEHICLES, PHASE B Technical Report, Jul. 1963–14 Feb. 1964
T. R. Strayhorn and N. L. Wilson Kirtland AFB, N. Mex., AF Weapons Lab., Jun. 1964 205 p refs
(Contract AF 29(601)-5852)
(FZK-177; WL-TDR-64-32; AD-443072)

Calculations have been performed that predict the radiation fluxes in the SNAP-10A–Agena-D and SNAP-2–Agena-D flight-test vehicles and the effects on shielding weight of various parameters. For the SNAP-10A system, the neutron flux level varied as much as a factor of 50 between the vehicle axis and the vehicle skin, whereas the gamma dose rate varied no more than a factor of 1.1. For the SNAP-2 system, the neutron fluxes and gamma dose rates were found to have almost no variance between the vehicle axis and vehicle skin. At positions on the vehicle axis near the mating plane of each system, the integrated neutron flux and gamma dose for a year were calculated to be 3.6×10^{12} n/cm^2 and 5.5×10^8 ergs/gm(C) for the SNAP-2 system, and to be 6.8×10^{12} n/cm^2 and 6.3×10^8 ergs/gm(C) for the SNAP-10A system. The power levels were 55 kw_{th} for SNAP-2 and 33 kw_{th} for SNAP-10A. Author

N64-30067 Phillips Petroleum Co., Idaho Falls, Idaho Atomic Energy Div.
AN ELECTROCHEMICAL CELL NOISE STUDY
R. H. Brown, L. G. Cloud, and S. J. Horn Jun. 1964 18 p refs
(Contract AT(10-1)-205)
(IDO-16975) OTS: $0.50

This report describes the noise output of a bubbling electrolytic cell under various conditions of cell operation. The noise spectrum is analyzed and integrated for the purpose of providing a potentiostat noise figure. The report also indicates how a noise spectrum may be used to gain further insight into electrochemical cell mechanisms. Author

N64-30092* National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
SIMULATOR STUDY OF PRECISE ATTITUDE STABILIZATION OF A MANNED SPACECRAFT BY TWIN GYROS AND PULSE-MODULATED REACTION JETS
Armando E. Lopez and Jack W. Ratcliff Washington, NASA, Sep. 1964 30 p refs
(NASA-TN-D-1645) OTS: $0.75

An automatic closed-loop system and a pilot-operated system were investigated with two different torque sources, a twin-gyro control system, and a pulse-frequency-modulated reaction control system. These systems were evaluated on a large space-vehicle attitude-motion simulator. The automatic closed-loop twin-gyro control system was able to maintain attitude about all three axes to within ± 1 second of arc. The response to step commands was rapid, and the system had good damping characteristics. The automatic closed-loop reaction control system was able to maintain attitude to within ± 3 seconds of arc. The dynamic response was not as rapid nor as well damped as the twin-gyro control system. With either torque source, the pilot was able to stabilize the vehicle to within ± 5 seconds of arc of the desired attitude about all axes. When the gains in the rate feedback loop were at their highest value, the pilots considered the reaction control system slightly better than the twin-gyro system. Author

N64-30101* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio
SUMMARY OF BRAYTON CYCLE ANALYTICAL STUDIES FOR SPACE-POWER SYSTEM APPLICATIONS
Arthur J. Glassman Washington, NASA, Sep. 1964 24 p refs
(NASA-TN-D-2487) OTS: $0.75

Presented are a description of the Brayton cycle, its thermodynamic behavior characteristics, component features and requirements, and weight and reliability considerations.
Author

07 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy); chemical engineering; chemical properties of materials; and synthesis. *For related information see*: 18 Materials, Metallic; 19 Materials, Nonmetallic; and 26 Propellants and Combustion.

N64-29023 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
CORROSION STUDY V. MECHANISM OF CHEMICAL PASSIVATION AND CORROSION OF METALS
M. Prazak and V. Prazak 2 Jul. 1963 14 p refs Transl. into ENGLISH from the Russian book "Sbornik Chekoslovak Khimii Rabot" v. 21, 1956 p 564–570
(FTD-TT-62-1721/1+2; AD-414112)

The progress of the chemical and electrochemical passivation and corrosion of iron in nitric acid of varying concentration was compared. The oxidation and reduction processes in these reactions were expressed with the aid of partial currents, the dependence of which was measured for the electrode potential for the anodic dissolving process of the iron and for

the cathodic reduction of the nitric acid, but separated in the form of a polarization curve. A diagram was set up by means of which the corrosion behavior of iron in nitric acid of a given concentration can be read. The results obtained showed that between the mechanism of the chemical and electrochemical corrosion reactions, a marked difference does not exist.

Author

N64-29119 Joint Publications Research Service, Washington, D.C.

RADIATION RESISTANCE OF PLASTIC MATERIALS

20 Aug. 1964 27 p refs Transl. into ENGLISH from Zashchitn. Pokrytiya v At. Tekhn. (Moscow), 1963 p 35–44, 80–92

(JPRS-26001; TT-64-41272) OTS: $2.00

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N64-29120 Joint Publications Research Service, Washington, D.C.

THE RADIATION RESISTANCE OF POLYVINYL CHLORIDE AND POLYMERIC MATERIALS BASED ON IT

M. N. Shteding *In its* Radiation Resistance of Plastic Mater. 20 Aug. 1964 p 1–10 (See N64-29119 21-07) OTS: $2.00

The effects of antiradiation and stabilizing–inhibiting additives of polyvinyl chloride under conditions of external gamma-irradiation were investigated. These effects were determined by a comparative estimate of the initial and terminal safety factors (determined on a dynamometer) for breaking and elongation of plates subjected to definite cycles of aging. Results point to the possibility of raising the radiation-resistance level of polymeric materials of the polyvinyl chloride type by the incorporation of such additives. I.v.L.

N64-29121 Joint Publications Research Service, Washington, D.C.

ADHESIVE "PED-B" FOR CEMENTING PLASTICS OF FORMULA 57-40 TO THE SURFACES OF CONSTRUCTION UNITS

G. V. Struminskiy, T. A. Ignatova, T. G. Ivanova, T. N. Katkova, and A. S. Zelenov *In its* Radiation Resistance of Plastic Mater. 20 Aug. 1964 p 11–24 refs (See N64-29119 21-07) OTS: $2.00

A glue is described for cementing radioactive-contamination protective coatings of Vinyl Blend 57-40 to the surfaces of building construction units. This glue consists of perchlorovinyl resin, 15 parts by weight; epoxide resin ED-5, 13 parts by weight; methylene chloride, 90 parts by weight; and cyclohexanone, 10 parts by weight. Polyethylene polyamine is added, as a hardener, in the amount of 1.5% to 2% of the weight of the finished product. The hardener enters into the glue composition directly before use, since the "life" of the glue, from the moment of introduction of the hardener, is 1.5 to 2 hours. In addition to describing the method of glue-preparation, this report discusses the mechanical properties of the glue, its sorption–desorption properties in connection with radioactive isotopes, its radiation resistance, and the technology of its application to vinyl-blend surfaces. I.v.L.

N64-29172 British Columbia U., Vancouver (Canada)

VOLATILE FLUORO COMPOUNDS Final Report, 15 Jul. 1958–31 Aug. 1963

H. C. Clark Aug. 1963 52 p refs

(Contract Nonr-2659(00))

(AD-423390)

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1. INTRODUCTION 8 p refs

2. STUDIES WITH A PERFLUOROALKYL-SILICON COMPOUND H. C. Clark, J. T. Kwon, and D. Whyman 14 p refs (See N64-29173 21-07)

3. REACTIONS OF ORGANOTIN COMPOUNDS. 1: THE STABILITY OF DIMETHYLTIN DIHYDRIDE, AND ADDITIONS TO SOME FLUORO-OLEFINS H. C. Clark, S. G. Furnival, and J. T. Kwon 19 p refs (See N64-29174 21-07)

4. SOME REACTIONS OF CHROMIUM TETRAFLUORIDE H. C. Clark and Y. N. Sadana 14 p refs (See N64-29175 21-07)

N64-29173 British Columbia U., Vancouver (Canada)

STUDIES WITH A PERFLUOROALKYL-SILICON COMPOUND

H. C. Clark, J. T. Kwon, and D. Whyman *In its* Volatile Fluoro Compounds Aug. 1963 14 p refs (See N64-29172 21-07)

Some detailed chemical studies are described of dimethylbis(perfluoropropyl)silane, (I), prepared from *n*-perfluoropropyllithium and dimethyldichlorosilane. The hydrolytic stability of (I) toward base is described, and pyrolyses in the temperature range 185° to 295°, leading to the formation of dimethyldifluorosilane, $(CH_3)_2SiF_2$, and fluorocarbons are discussed. Chlorination of (I) leads to stepwise chlorination of the CH_3 groups, and even excess chlorine, does not cause cleavage. Bromine does not react with (I). The reaction of (I) with iodine and catalytic amounts of aluminum in boiling toluene causes rapid cleavage of C_3F_7 as C_3F_7I. The mechanisms of some of these reactions are discussed. Author

N64-29174 British Columbia U., Vancouver (Canada)

REACTIONS OF ORGANOTIN COMPOUNDS. I. THE STABILITY OF DIMETHYLTIN DIHYDRIDE, AND ADDITIONS TO SOME FLUORO-OLEFINS

H. C. Clark, Sharon G. Furnival, and J. T. Kwon *In its* Volatile Fluoro compounds Aug. 1963 19 p refs Presented at the Symp. on Current Trends in Organometallic Chem., Cincinnati, 12–15 Jun. 1963 (See N64-29172 21-07)

The effect of heat and ultraviolet irradiation on dimethyltin dihydride is reported. At 120°, the major decomposition products are $(CH_3)_3SnH$, Sn, and H_2, with a small amount of $(CH_3)_6Sn_2$. At 130° under ultraviolet light, decomposition is much more rapid giving $(CH_3)_3SnH$, Sn, and H_2, and an appreciable quantity of $(CH_3)_4Sn$. If the dihydride is maintained under these conditions for a longer period (40 hours), $(CH_3)_6Sn_2$ is formed in place of $(CH_3)_3SnH$, and other products are $(CH_3)_4Sn$, Sn, and H_2. Negligible decomposition occurs at 25° even under irradiation. The ready addition of C_2F_4 to $(CH_3)_2SnH_2$ gives the first reported monoaddition product of an organotin dihydride, $(CH_3)_2SnH(C_2F_4H)$, as well as $(CH_3)_2Sn(C_2F_4H)_2$. Physical and chemical properties of these compounds are described. The additions of $(CH_3)_2SnH_2$ to CF_2CFH, CF_2CH_2, and CF_2CFBr are reported, and the results are interpreted in terms of the formation of unstable monoaddition products, $(CH_3)_2SnH(C_2F_nX_mH_p)$. Author

N64-29175 British Columbia U., Vancouver (Canada)
SOME REACTIONS OF CHROMIUM TETRAFLUORIDE
H. C. Clark and Y. N. Sadana *In its* Volatile Fluoro Compounds Aug. 1963 14 p refs (See N64-29172 21-07)

Chromium tetrafluoride is surprisingly inert and does not react with ammonia, sulphur di- or tri-oxide, pyridine, halogen fluorides, or selenium tetrafluoride at ordinary temperatures. In boiling bromine trifluoride or selenium tetrafluoride, chromium tetrafluoride is reduced to lower fluorides, while a refluxing mixture of bromine tri- and penta-fluorides converts CrF_4 to $CrOF_3 \cdot 0.25BrF_3$. Chromium (IV) fluoride complexes of the types $ACrF_5$ (A = K, Rb, or (s)) and A_2CrF_6 (A = K, or (s)) have been prepared, and their magnetic moments and lattice constants have been determined. Author

N64-29186* Lockheed Missiles and Space Co., Palo Alto, Calif. Research Labs.
ELECTROLYTIC PREPARATION OF HIGH DIELECTRIC THIN FILMS Annual Report, 27 Jun. 1963–27 Jun. 1964
A. E. Hultquist and M. E. Sibert [1964] 52 p refs
(Contract NASw-765)
(NASA-CR-58503) OTS: $5.60 ph

The preparation of high dielectric thin films is described, and the results are compared and interpreted with the results reported by others working this area. A secondary oxide can be deposited in a simultaneously formed oxide film by electrolytic conversion methods. However, it is doubtful that doping the film with small amounts of secondary oxides by use of normal anodization techniques produces any major improvement in electrical characteristics. Deposition of dispersed high dielectric material on the anode has been accomplished.
Author

N64-29235 Portugal Nuclear Energy Commission, Sacavem Laboratorio de Fisica e Engenharia Nucleares
INFLUENCE OF NITRIC ACID ON THE REDUCTION OF CERIC IONS UNDER α RADIATION [INFLUENCIA DO ACIDO NITRICO SOBRE A REDUCAO DOS IOES CERICOS SOB A ACCAO DE RAIOS α]
Maria do Carmo Anta and Artur Marques da Costa 1963 10 p refs In PORTUGUESE and FRENCH Repr. from J. Chim. Phys. (Paris), v. 57, 1960 p 1130–1131
(LFEN-2)

The action of HNO_3, of a concentration range between 10^{-3} M and 3 M, on a 2.10^{-4} M to 10^{-3} M solution of Ce^{+4} ions in a 0.4 M H_2SO_4 medium was investigated, in the presence of air, under polonium alpha-irradiation. Results of the reduction of Ce^{+4} ions to Ce^{+3} ions, as a function of HNO_3 concentration, show that the increase in reduction is directly proportional to the increse in concentration. These results were applied to the following equations: $NO_2^- + 2Ce^{+4} + H_2O \rightarrow NO_2^- + 2Ce^{+3} + 2H^+$ (I), $NO_3^- + H \rightarrow NO_2 + OH^-$ (II), and $2NO_2 + H_2O \rightarrow NO_3^- + NO_2^- + 2H^+$ (III), in order to explain the behavior of solutions of low NO_3^- concentrations. In effect, if NO_3^- is added to the solutions, reactions (I), (II), and (III) replace the reduction reaction of Ce^{+4} by H atoms a yield represented by $G(Ce^{+3}) = 2G_{H_2O} + G_H + G_{HO_2} - G_{OH}$ results, with or without the presence of NO_3^-. A hypothesis was proposed concerning the direct action of irradiation on NO_3^- ions. The assignment of the increase in the product of the reaction $NO_3^- \rightsquigarrow NO_2^- + 1/2O_2$ makes it possible to obtain, for the yield of NO_2^- formation, the empirical equation $G_{NO_2^-} = 2.74 + 1.61 \log(NO_3^-)$, which is analogous to that deduced for gamma rays. I.v.L.

N64-29297 Princeton U., N.J. Frick Chemical Lab.
[LOW MOLECULAR WEIGHT COMPOUNDS CRYSTAL AND MOLECULAR STRUCTURE INVESTIGATION] Final Technical Report
Robert A. Jacobson Aug. 1964 12 p refs
(Grants DA-ARO(D)-31-124-G12; DA-ARO(D)-31-124-G285; DA-ARO(D)-31-124-G184; NSF GP-79)
(AROD-3983-15; AD-445623)

In the investigation of the crystal and molecular structure of low-molecular-weight compounds, particularly small polymer molecules, the primary structure determination method used was that of single-crystal X-ray diffraction. A strong emphasis was also placed on attempts to extend present structure determination methods and to develop new ones, whenever possible. A complete series of crystallographic programs was written for the 1604 computer. To improve and facilitate the intensity collection procedures, a technique that uses a balanced pair of Zr and Y filters (Mo radiation) has been employed on an XRD-5 equipped with single crystal orienter and scintillation counter. Both the scan technique and the stationary count technique (using a peak to integrated intensity curve) have proven very satisfactory; some of the structure determinations are reported. Author

N64-29332 California U., San Francisco
SYNTHESIS OF STEREOSPECIFIC AMINOTHIOLS AS RADIOPROTECTIVE AGENTS Progress Report, Jul. 1, 1962–Mar. 1, 1963
J. Cymerman Craig [1963] 3 p
(Contract DA-49-193-MD-2145)
(AD-601839)

The use of 2-methylcyclopentanothiazoline for the preparation of *cis*-2-aminocyclopentanethiol was investigated. The required 2-methylcyclopentanothiazoline was prepared from *trans*-2-acetamidocyclopentanol acetate by the action of phosphorus pentasulfide. The following methods for producing the desired thiol were attempted: (1) hydrochloric-acid hydrolysis; (2) reduction by various types of reducing agents; (3) reaction of the thiazoline with methanesulfonyl chloride in pyridine; (4) treatment of the thiazoline with exactly one mole of benzoyl chloride in pyridine; (5) ring fission of the thiazoline with exactly one mole of acetyl chloride in benzene, and with exactly one mole of acetic anhydride in pyridine; and (6) treatment of the thiazoline with an excess of acetic anhydride. None of these methods were successful. Method (1) resulted only in hydrochlorination. Method (2) failed to change the compound. Method (3) produced S-acetyl-*cis*-2-methanesulfonamidocyclopentanethiol. Method (4) produced S-acetyl-*cis*-benzamidocyclopentanethiol. Method (5), in each instance, gave S-acetyl-*cis*-2-acetamidocyclopentanethiol. Method (6) produced *cis*-1-acetyl-2-methyl-4-oxobicyclo-[5.0.3]-1-aza-5-thiadec-2-ene. Alkali and acid hydrolysis of S-acetyl-*cis*-2-acetamidocyclopentanethiol were also attempted; the only product was the thiazoline. I.v.L.

N64-29333 California U., San Francisco
SYNTHESIS OF STEREOSPECIFIC AMINOTHIOLS AS RADIOPROTECTIVE AGENTS Interim Progress Report, 1 Mar. 1963–1 Mar. 1964
J. Cymerman Craig [1964] 8 p
(Contract DA-49-193-MD-2145)
(AD-601838)

Trans-2-(n-octylamino)-cyclopentanthiol and *trans*-2-(n-decylamino)-cyclopentanthiol have been synthesized and submitted for testing. The preparation of *cis*- and *trans*-1-amino-indane-2-thiol is in progress. Successful reduction

methods have been developed for the preparation of 2-methyl-4,5-cyclopentano-thiazolidine and *spiro*-2,2-cyclohexano-4,5-cyclopentano-thiazolidine. The conversion of these two key compounds into the required *cis*-2-aminocyclopentanthiol is under examination. Author

N64-29346 Washington U., Seattle
REACTIONS OF XENON HEXAFLUORIDE WITH THE SUBSTANCES: SbF_5, HCl, NH_3 AND c-C_5F_8
Gary L. Gard and George H. Cady 1964 16 p refs
(Contract Nonr-477(16); ARPA Order 26-60)
(TR-49; AD-443503)

By varying the proportions of the reactants antimony pentafluoride and xenon hexafluoride, it is possible to prepare each of the crystalline solids: $XeF_6 \cdot 2SbF_5$, $XeF_6 \cdot SbF_5$, $SbF_5 \cdot 2XeF_6$. Hydrogen chloride, ammonia, and perfluorocyclopentene react readily with xenon hexafluoride, but the products have not been found to include substances in which xenon is in combination with chlorine, nitrogen, or carbon, respectively. Author

N64-29404* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
MICROWAVE SPECTRUM, BARRIER TO INTERNAL ROTATION, AND QUADRUPOLE COUPLING CONSTANTS OF CIS-1-CHLOROPROPYLENE
Robert A. Beaudet Repr. from J. Chem. Phys., v. 40, no. 9, 1 May 1964 p 2705–2715 refs
(Contract NAS7-100)
(NASA-CR-58578; JPL-TR-32-613)

The microwave spectra of $CH_3CH{=}CHCl^{35}$ and $CH_3CH{=}CHCl^{37}$ were studied in the region from 8 to 35 kmc/sec. The height of the potential barrier hindering the internal rotation of the methyl top is 620 cal/mole; the Cl quadrupole coupling constants are $\chi_{aa}Cl^{35} = -19.66$ mc/sec and $\chi_{bb}Cl^{35} = 31.05$. The dipole moments are $\mu_a = 1.47$ D and $\mu_b = 0.72$ D. The even greater lowering of the barrier, *trans* to *cis*, for the chlorine compounds as compared with the fluorine analogs supports the hypothesis of a nonbonded interaction between the halogen and the methyl hydrogen atoms. Author

N64-29414 American Meteorological Society, Boston, Mass.
SEMICONDUCTOR PROPERTIES OF ORGANIC DYES. II. TRYPAFLAVINE [POLUPROVODNIKOVYE SVOISTVA ORGANICHESKICH KRASITELEI. II. TRIPAFLAVIN]
A. T. Vartanian Aug. 1963 17 p refs Transl. into ENGLISH from Zh. Fiz. Khim. (Moscow), v. 24(11), 1950 p 1361–1370
(Contract AF 19(604)-6113)
(T-R-403; AD-602188)

Chemically pure trypaflavine has been prepared by crystallization from an alcoholic solution, and a thin film of the dye has been deposited on quartz. The intrinsic photoelectric effect of the dye was enhanced by illumination, increasing the conductivity of the film. Results show that upon illumination of trypaflavine solid films in a vacuum, a photocurrent is observed that is proportional to the light intensity and applied field strength. The photoconductivity of the film is greater in oxygen than in a vacuum. D.E.R.

N64-29433 General Electric Co., Philadelphia, Pa. Space Sciences Lab.
VAPOR DEPOSITED BORIDES OF GROUP IVA METALS
J. J. Gebhardt and R. F. Cree Jun. 1964 32 p refs Presented at the Am. Ceram. Soc. Symp. on Cerams. Processed at Subconventional Temps., Chicago, 22 Apr. 1964
(Contract AF 04(694)-222)
(R64SD46; AD-601861)

The formation of vapor deposited TiB_2, ZrB_2, and HfB_2 at 1,400° C was studied with respect to the influence of process variables on structure and stoichiometry. Stoichiometric, nonporous deposits of TiB_2 were obtained; ZrB_2 and HfB_2 deposits contained β-rhombohedral boron. Precision lattice parameters were determined for all three diborides. The effect of codeposited boron on these parameters appears to be slight. A small degree of preferred orientation existed in materials made under these conditions, which indicates that crystallites tend to be deposited with c axes parallel to the substrate. Grain size, orientation, porosity, and stoichiometry are all influenced and therefore should be controllable by process variation. Author

N64-29441 Florida U., Gainesville College of Engineering
FLUOROCARBON N-F COMPOUNDS Final Report, Aug. 1, 1959–Jun. 26, 1964
R. D. Dresdner [1964] 26 p refs
(Contract DA-01-009-ORD-772; ARPA Order 40-59)
(AROD-007-20; AD-423279)

Abstracts of published papers and brief summaries of the various phases of research, conducted during a program of study of N–F chemistry, are presented. Papers abstracted are: (1) "A Laboratory Scale Preparation of N_2F_4"; (2) "A Preparation of Primary Perfluoroalkyl Amines"; (3) "The Indirect Fluorination of Some Fluorocarbon Nitrogen Derivatives"; (4) "Mono-, Di-, Tri-, and Tetra-Acyl Derivatives, Oxadiazoles and ω-Bromo Acyl Isocyanates"; (5) "The Reaction of Nitriles with Carboxylic Acids"; and (6) "N,N-Difluoroamines from Azoalkanes." Research summaries pertinent to the following are given: (1) the electrolysis of pyridine in anhydrous HF; (2) the CsF catalyzed fluorocarbon reactions involving the generation of a fluorocarbon carbonion; (3) gamma irradiation of C_5F_8 isomers; (4) the reaction chemistry of N_2F_4 with ultraviolet stimulus; and (5) reactions of high-valency metal fluorides with $R_fN{=}SF_2$. I.v.L.

N64-29503* Radiation Applications, Inc., Long Island City, N.Y.
WATER RECOVERY STUDY, SEPTEMBER 7, 1962–MARCH 7, 1964
Richard Everett Jr., Eric Meier, George Odian, Ernest Henley, Arnold Katz et al 15 Apr. 1964 109 p refs
(Contract NASw-520)
(NASA-CR-58700; RAI-337) OTS: $9.10 ph

The research program has resulted in the demonstration of a system of water recovery from urine based upon ultrafiltration preceded by electrolytic urea removal (the EUF system). The chloride ion in the salt is converted to Cl_2, which in turn forms hypochlorous acid, HOCl. The HOCl oxidizes the urea and other organic matter to N_2, CO_2, and H_2O. Concurrently, the evolved hypochlorite serves to sterilize the urine, as independent *E. coli* counts have demonstrated. The electrolyzed urine is pumped through a cellulose acetate membrane that rejects NaCl, but passes water. Water meeting USPHS specifications has been recovered from the subject process. Author

N64-29525 Thiokol Chemical Corp., Denville, N.J.
DIELECTRIC MATERIALS FOR HIGH TEMPERATURE EVALUATION, 16 DECEMBER 1963 TO 30 APRIL 1964
Nathan Mayes [1964] 31 p refs
(Contract NObs-90065)
(RMD-5038-F; AD-601945)

Investigation of methods to prepare carborane silozane polymers determined that cohydrolysis of dimethyldichlorosilane and (4-carboranylbutyl) methyldichlorosilane yielded products that could be solvent fractionated to approximately 50% cyclosilozanes and low molecular weight polymer, and 50% linear, hydroxy terminate polymer of molecular weight 7,000 to 14,000. A rubbery polymer was prepared by addition of butenylcarborane to a high molecular weight copolymer of methyl hydrogen siloxane and dimethyl siloxane. The curing behavior of carborane siloxanes was studied to determine their potential for use in varnishes, laminates, elastomers, and plastics. High-temperature application studies showed carborane siloxane polymers to be noncorrosive to carbon brushes in a simulated sealed electric motor operating at 185° C.
P.V.E.

N64-29526 Los Alamos Scientific Lab., N. Mex.
BODPRO II: ANALYSIS OF T_4-BACTERIOPHAGE ULTRACENTRIFUGAL BOUNDARIES
G. R. Shepherd, B. J. Noland, and P. N. Dean 10 Aug. 1964 30 p refs
(Contract W-7405-ENG-36)
(LA-3098) OTS: $0.75

A detailed investigation was made of the effects of concentration, rotor speed, and boundary height upon ultracentrifugal sedimentation rates of T_4-bacteriophage DNA. All experimental data were submitted to a computer program (BODPRO) for computation and analysis. Boundary anomalies such as buckling, reversal, and intermittent rate changes were observed and found to be dependent upon concentration and, to a lesser degree, upon rotor speed. Sedimentation rates were observed to be dependent upon rotor speed at concentrations of 5 to 100 μg DNA/ml, though the degree of dependence lessened with increasing concentration. Sedimentation rates at all rotor speeds were found to be greatly dependent upon concentration, increasing with concentration to the region of 50 to 75 μg DNA/ml and decreasing rapidly beyond this point.
Author

N64-29541 Joint Publications Research Service, Washington, D.C.
STUDIES IN CHEMICAL DOSIMETRY OF IONIZING RADIATIONS
A. M. Kabakchi et al 11 Sep. 1964 48 p refs Transl. into ENGLISH of Excerpts from the book "Khimicheskaya Dozimetriya Ioniziruyushchikh Izlucheniy" Kiev, 1963 p 77–85, 93–104, 136–153, 155
(JPRS-26363; TT-64-41622) OTS: $2.00

CONTENTS:
1. METHODS IN CHEMICAL DOSIMETRY p 1–10 refs
2. UTILIZATION OF POLYMERS AND ORGANIC COMPOUNDS IN CHEMICAL DOSIMETRY p 11–24 refs
3. DETERMINATION OF DOSES OF VARIOUS TYPES OF RADIATIONS USING CHEMICAL METHODS p 25–43 refs

N64-29545 Washington U., Seattle
CHEMICAL ACTIVATION
B. S. Rabinovitch and M. C. Flowers 6 Jan. 1964 77 p refs
(Contract Nonr-477(36))
(TR-1; AD-427135)

This review brings together known examples of chemical activation systems in order to clarify their nature and to exemplify their usefulness. The major emphasis is on activated molecules produced in the electronic ground states; these are the simplest systems. However, a brief mention of some reactions involving electronic excitation are given, since these include important examples of chemical activation. The main body of this review deals with the following: (1) the general characterization of chemical activation—microscopic reversibility, exothermic and endothermic processes, and potential energy surfaces; and (2) reaction types giving rise to chemical activation—unimolecular isomerization, unimolecular decomposition, bimolecular association, bimolecular exchange or displacement, and "trimolecular" reaction, with emphasis on bimolecular association and bimolecular exchange or displacement.
I.v.L.

N64-29549* Southern Research Inst., Birmingham, Ala.
A STUDY OF POLYMERS CONTAINING SILICON-NITROGEN BONDS Annual Summary Report, Apr. 4, 1963–Apr. 3, 1964
Robert E. Burks, Jr. and Thomas W. Ray 28 May 1964 168 p refs
(Contract NAS8-1510; Proj. 1259)
(NASA-CR-56415; Rept.-38) OTS: $12.00 ph

A large amount of information had been obtained on the ability of silicon–nitrogen compounds to polymerize, to endure thermal stress, and to resist chemical action. The work was extended, and substantially better materials were developed for coatings and elastomers. Improvements were made in the thickness, flexibility, and thermal endurance of protective coatings on metals and in the toughness and thermal endurance of elastomers. An improvement was made in the method of carrying out the reaction of chlorosilanes with ammonia. In addition, a number of routes to polymers were studied and rejected as being of relatively little value.
Author

N64-29598 American Meteorological Society, Boston, Mass.
STUDIES OF CHELATE POLYMERS. V: CHELATE POLYMERS OF BIS-DITHIOCARBAMIC ACIDS AND METALS [ISSLEDOVANIA V RIADU KLELATNYKH POLIMEROV. V: KHELATNYE POLIMERY BIS-DITIOKARBAMINOVYKH KISLOT S METALLAMI]
A. P. Terent'ev, E. G. Rukhadze, and V. V. Rode Bedford, Mass. AFCRL, Mar. 1964 14 p refs Transl. into ENGLISH from Vysokomol. Soedineniia (USSR), v. 4, no. 6, 1962 p 821–827
(Contract AF 19(628)-3880)
(T-R-432; AD-602190)

Chelate polymer compounds in which sulfur atoms act as electron donors were investigated. Compounds with a chelate branch point of the type 2(S,S)-M were emphasized. Chelate polymers of ethylene-, hexamethylene-, p-phenylene, and p,p'-diphenylene-bis-dithiocarbamic acids with the following metals were obtained: divalent nickel, zinc, and cobalt, and monovalent copper. The investigation showed that when divalent salts of copper react with disodium salts of bis-dithiocarbamic acids, the copper is reduced to monovalent copper, and the sulfur and carbon oxysulfide are released simultaneously, forming a reticular structure polymer containing copper. Few

cyclic structures were formed in the polychelates of nickel, zinc, and cobalt with ethylene- and hexamethylene-bis-dithiocarbamic acids. The molecular weight of the polymers of nickel and zinc agree well with earlier results for similar macromolecular structures. M.P.G.

N64-29621 Naval Ordnance Lab., White Oak, Md.
PRINCIPAL INFRARED ABSORPTION BANDS OF SOME DERIVATIVES OF 1,3-DINITROBENZENE AND 1,3,5-TRINITROBENZENE
Thomas N. Hall and John P. Haberman Jul. 1964 25 p refs
(NOLTR-64-62; AD-442908)

The frequencies of the strong infrared absorption bands of 46 derivatives of di- and tri-nitrobenzene have been measured and tabulated. The vibrational modes producing these absorptions were assigned in most cases. The effect of structure on the frequency of the absorption due to each of the modes is discussed, with emphasis on identifying unknowns. Author

N64-29637 General Precision, Inc., Little Falls, N.J. Aerospace Research Center
HIGH-TEMPERATURE RESISTANT POLYMERS Quarterly Progress Report, 1 Apr.–30 Jun. 1964
C. Vogel 15 Jul. 1964 22 p
(Contract NObs-90194)
(QPR-2; AD-602794) OTS: $2.00

This is a report of the program for the preparation of high-temperature stable phthalocyanine polymers. Chloraluminum phthalocyanine was prepared and treated with a number of different basic reagents. These included aniline, pyridine, thiourea, DABCO, and phenyl magnesium bromide. Stable reaction products were isolated only with the latter two reagents. The $PcSi(OH)_2$ when treated with $nC_{18}H_{37}OH$ in refluxing tetralin followed by contact with ethanol yielded $PcSi(OC_2H_5)_2$. Author

N64-29724 London U. (Gt. Brit.) Birkbeck Coll.
X-RAY CRYSTALLOGRAPHIC STUDIES OF AMINOBORANES AND RELATED COMPOUNDS Final Technical Report, 1 Oct. 1962–31 Mar. 1964
G. J. Bullen [1964] 18 p
(Contract DA-91-591-EUC-2713)
(FTR-1; AD-602136)

The lattice parameters and space groups of crystals of five compounds containing B-N bonds have been determined, by means of X-ray photographs, as a preliminary to a detailed X-ray structure analysis of some of these substances. B-Trifluoroborazole is trigonal (rhombohedral) with $\underline{a} = 11.47$ A, $\underline{c} = 7.01$ A, space group $R\bar{3}c$ or $R3c$. The other four substances are all monoclinic with the parameters shown in a table. Diisopropylamino-(p-bromophenyl)phenylborane was also examined, but it proved impossible to produce single crystals of this compound suitable for X-ray work. Author

N64-29779 Oak Ridge National Lab., Tenn. Div. of Technical Information Extension
RADIOISOTOPES IN WORLD INDUSTRY: ABSTRACTS OF SELECTED FOREIGN LITERATURE
Aug. 1964 130 p refs
(TID-6613(Suppl. 5)) OTS: $2.50

An annotated bibliography of 500 articles is presented. The abstracts are grouped by subject and subgrouped by country. The subject categories are as follows: (1) applications by topic, e.g., adsorption; (2) applications by industry; (3) health and safety; and (4) instruments. Author and country indexes are appended. In addition, an index to the Library of Congress card numbers is given for the abstracts. (U.S. AEC Commission, Division of Technical Information, July 1964.) I.v.L.

N64-29781* General Electric Co., Philadelphia, Pa. Re-Entry Systems Dept.
FORMING ALUMINUM FOR SOLAR ENERGY CONCENTRATORS Materials Report, 1 Oct. 1963–31 Mar. 1964
F. J. Schmidt and I. J. Hess 27 Apr. 1964 20 p refs
(Contract NAS1-3309)
(NASA-CR-56408) OTS: $1.60 ph

This report describes the tests, experiments, developments, and studies in various problem areas relating to aluminum electroforming and scale-up of the process. Consideration was given to all alternative plating solutions reported in the literature. A hydride-type plating bath was adjudged as, presently, the most promising, as regards deposit quality and process control. The investigation established that a 3.4M $AlCl_3$–0.4M $LiAlH_4$–diethyl ether solution represented the optimum composition for the hydride-type bath. Author

N64-29800 Aerospace Corp., El Segundo, Calif. Materials Sciences Lab.
C_2F_2
Julian Heicklen and Vester Knight 31 Jul. 1964 7 p refs
(Contract AF 04(695)-269)
(TDR-269(4240-20)-6; SSD-TDR-64-153; AD-604106)

The preparation, purification, and infrared spectra of C_2F_2 are described. The compound was prepared by three different methods—the photolysis of C_2F_4, the photolysis of C_3F_6, and the pyrolysis of C_3F_6 at temperatures of about 400° to 600° C. All three methods apparently produce C_2F_2 through the C_2F_3 radical as a precursor. During the gas chromatographic analysis, the peak believed to be C_2F_2 was isolated and trapped in liquid nitrogen. This product was then purified by again passing it through the column. The infrared spectrum of the purified product was observed in a Perkin–Elmer 21 spectrometer. With only a few tenths of a millimeter sample, a very intense peak was observed at 1,149 cm^{-1}, and one peak at least 10 times weaker at 1,370 cm^{-1}. The ratios of the two bands did not appear constant. This spectrum corresponds to no known perfluorinated compound, and can be associated with C_2F_2. I.v.L.

N64-29807 National Carbon Co., Parma, Ohio Research Lab.
RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS. SUPPLEMENT TO VOLUME X: THERMAL REACTIVITY OF AROMATIC HYDROCARBONS Technical Documentary Report, May 1, 1960–Oct. 15, 1961
T. Edstrom and I. C. Lewis Wright-Patterson AFB, Ohio, AF Mater. Lab., Mar. 1964 72 p refs
(Contract AF 33(616)-6915)
(WADD-TR-61-72, Vol. X, Suppl.; AD-601832)

A survey of the thermal reactivity of 84 aromatic hydrocarbons was given previously. This supplement presents the extension of this study to 26 new aromatic hydrocarbons, 25 heterocyclic compounds, 76 substituted aromatics, and 14 binary mixtures of aromatic compounds. Differential thermal analysis was employed to delineate the thermal behavior during pyrolysis to 750° C in an argon atmosphere. Emphasis has been placed on the role of heteroatoms and the effects of ring substituents on the thermal reactivity of aromatic hydrocarbon precursors to carbon and graphite. Author

N64-29843 Naval Research Lab., Washington, D.C. Chemistry Div.

SOLUBILIZATION OF POLAR SPECIES BY MICELLE-FORMING SOAPS IN A NONPOLAR SOLVENT

Samuel Kaufman 31 Jul. 1964 9 p refs

(NRL-6122; AD-604558)

The solubilization of diethyl ether, acetone, n-propylamine, and methyl acetate by sodium and magnesium dinonylnaphthalene sulfonates in toluene solution was studied by gas–liquid chromatography. Results are compared with data for the solubilization of methanol and acetic acid. Of the solubilizates studied, all were less extensively solubilized than methanol. Within the scope of the data, n-propylamine and acetic acid were solubilized approximately equally by the magnesium soap, but the sodium soap solubilized the acid more vigorously than the amine. The ether and ketone were only faintly solubilized, and the ester occupied an intermediate position. The data are consistent with conclusions derived from earlier studies of micelle formation and solubilization by the same soaps. At very dilute concentrations of solubilizate, the cation of the soap controls the interaction, but with increasing concentrations, after the coordinating tendency of the cation is satisfied, the anion is the effective moiety. Author

N64-29869 National Research Corp., Cambridge, Mass. Research Div.

HEAT OF FORMATION OF BORON TRICHLORIDE (BCl_3) Special Report

Ludwig G. Fasolino 15 Jul. 1964 22 p refs

(Contract Nonr-3608(00))

(AD-604433)

The heat of solution of BCl_3 (liq.) was determined calorimetrically in a closed reaction vessel. The process was carried out adiabatically and resulted in the following: BCl_3 (liq.) + 3 H_2O + 590 $H_2O \longrightarrow$ 3 HCl + H_3BO_3 + 590 H_2O; and $\Delta H_{hyd.298} = -69.12 \pm 0.11$ kcal/mole. From this value and the heats of formation data of the products and water, the heat of formation of BCl_3 (liq.) was calculated: ΔHf_{298} BCl_3 (liq.) = -101.04 ± 0.39 kcal/mole. Author

N64-29891 California U., Livermore Lawrence Radiation Lab.

VAPOR PRESSURE AND EVAPORATION COEFFICIENT STUDIES OF STANNIC OXIDE, ZINC OXIDE, AND BERYLLIUM NITRIDE

Clarence Leonard Hoenig (Ph.D. Thesis) 8 Apr. 1964 136 p refs

(Contract W-7405-ENG-48)

(UCRL-7521) OTS: $2.50

A Knudsen study of the reaction $SnO_{2(c)} = SnO_{(g)} + 1/2\ O_{2(g)}$ yielded for the enthalpy of decomposition of $SnO_{(g)}$, $D_0 = 5.44 \pm 0.1$ ev/molecule, which is in agreement with literature values (average 5.5 ± 0.1 ev/molecule) obtained by various methods. Langmuir studies indicated an evaporation coefficient upper limit of 0.1 for the measured reaction. Knudsen studies of the reaction $ZnO_{(c)} = Zn_{(g)} + 1/2\ O_{2(g)}$ yield enthalpy of reaction, which is in agreement with values calculated from thermochemical data. Langmuir studies indicate an evaporation coefficient upper limit of 0.01 to 0.001 for this reaction. Beryllium nitride evaporates congruently in the temperature region 1640° to 1950° K according to the reaction $Be_3N_{2(c)} = 3\ Be_{(g)} + N_{2(g)}$. The measured enthalpy of decomposition yields an enthalpy of formation for $Be_3N_{2(c)}$ of -136 ± 5.0 kcal/mole, which is in good agreement with the literature (-137.8 ± 1.5 kcal/mole). Be_3N_2 has an evaporation coefficient upper limit of 0.001. Author

N64-29897 Tracor, Inc., Austin, Tex.

ELECTROCHEMICAL STUDIES IN THE SYNTHESIS OF N-F COMPOUNDS Quarterly Status Report No. 5, 1 Jan.–31 Mar. 1964

Larry G. Spears, Larry D. Fiel, Wallace E. Harrell, Jr., and Gerhard M. Schmid 9 Jul. 1964 41 p refs

(Contract Nonr-4054(00); ARPA Order 399)

(TRACOR-64-228-U; AD-442627)

Work is described in the development of a suitable working electrode for use in electrochemical fluorination studies in anhydrous HF (AHF). Investigations of possible working electrodes have involved antimony, bismuth, silver, aluminum, titanium, cobalt, iron, and monel. Antimony, bismuth, and silver show a high anodic dissolution rate in AHF, whereas the other metals studied show passive behavior. Of the latter metals, only monel formed a protective coating that permitted appreciable fluorine evolution to occur. Author

N64-29901 Air Force Systems Command, Wright-Patterson AFB, Ohio AF Materials Lab.

INFRARED SPECTRA OF TRANSITION METAL ALKOXIDES Technical Documentary Report, Feb. 1963–Feb. 1964

C. T. Lynch, K. S. Mazdiyasni, J. S. Smith, and W. J. Crawford May 1964 29 p refs

(ML-TDR-64-124; AD-604688)

The infrared spectra of a number of transition metal isopropoxides and tetra tertiary butoxides have been obtained from 5000 cm^{-1} to 285 cm^{-1} for the first time. The spectra have been compared to existing infrared data on these classes of compounds. Characteristic absorptions for the isopropoxy group have been found at 1,160 to 1,175 cm^{-1} and at 1,120 to 1,140 cm^{-1}. They are assigned to isobranching vibrations. The isopropoxides exhibit a doublet at about 1,375 cm^{-1} and 1,365 cm^{-1} characteristic of the gem-dimethyl structure. The major feature of the spectra is a very strong band in the 1,000 cm^{-1} region assigned as the C-O stretch vibration, which is shifted by the influence of the specific metal atom on the C-O vibration. The butoxides have four characteristic absorptions at about 785 cm^{-1}, 900 cm^{-1}, 1,010 cm^{-1}, and 1,190 cm^{-1}. Author

N64-29917 Picatinny Arsenal, Dover, N.J. Feltman Research Labs.

SOLUTION PROPERTIES OF POLY(ISOBUTYL METHACRYLATE). II: VISCOSITY IN ACETONE

Richard J. Valles Jul. 1964 35 p refs

(TR-3163; AD-444991)

The viscosities of acetone solutions of high-molecular-weight poly(isobutyl methacrylate) were found to be shear dependent. Shear corrections were applied by using a five-bulb capillary viscometer. The data were treated in the same fashion as the methyl ethyl ketone data, using the double plot method and a triple plot method, and including a higher concentration term. The plots of reduced viscosity and inherent viscosity versus concentration displayed more curvature than the same plots obtained from the methyl ethyl ketone data. In addition, the solution viscosities in acetone did not show a regular relation with those in MEK, especially for the higher molecular weight fractions. The inherent viscosities appeared to have more curvature than the reduced viscosities in many cases, which was not expected. Author

N64-29921 Rice U., Houston, Tex.
RESEARCH IN FLUORINE CHEMISTRY Progress Report, 1 Apr.–30 Jun. 1964
John L. Margrave [1964] 6 p refs
(Contract DA-31-124-ARO(D)-110)
(PR-4; AD-445624)

The current program status includes the following activities: (1) Work has continued on the determination of the heats-of-formation of the polymorphic forms of titanium dioxide from their heats-of-combustion in fluorine. Mass spectrometry has indicated that the only gaseous combustion product was oxygen. (2) Mass spectrometric studies of $NiF_2(g)$, $MnF_2(g)$, and MnF(g) have been completed. (3) The rates of sublimation and vaporization of CrF_2 were measured between 1,115° and 1,333° K, by the Knudsen technique, employing the high-temperature, magnetic, mass spectrometer. The $CrF_2(s)$ was observed to melt at about 900° C instead of 1,100° C, as previously reported. (4) The reaction $2CrF(g) = Cr(g) + CrF_2(g)$ is under study. The determination of $\Delta H°_{298}$ for this reaction will allow the calculation of the dissociation energy of CrF(g). (5) Synthesis of new fluorine compounds has continued. This includes the preparation of SiF_2, by the action of SiF_4 on Si at low pressures and at about 1,200° C, and kinetic studies on the fluorination of TiB_2. I.v.L.

N64-29923 Minnesota U., Minneapolis
ACID-BASE EQUILIBRIA IN BENZENE. I. A COLLIGATIVE PROPERTY AND INFRA-RED STUDY OF THE REACTIONS OF SOME CARBOXYLIC ACIDS AND NITROGEN BASES Interim Technical Report
S. Bruckenstein and Atsuoshi Saito 3 Aug. 1964 54 p refs
(Grant DA-ARO-D-31-124-G232)
(AROD-3165-1; AD-44638)

The reaction of primary, secondary, and tertiary amines (B) with carboxylic acids (HX) in benzene as solvent was studied at a base concentration of 0.01 M. A dynamic differential vapor-pressure technique and infrared spectroscopy were used to establish the stoichiometry of the acid-base reactions. The principal species identified were ion pairs and other uncharged ionic aggregates. Three types of ion pairs are postulated: BH^+X^-, $BH^+HX_2^-$, and $BH^+X(HX)_2^-$. These ion pairs tend to form oligimers; the stronger the acid or base, the greater the oligimer formation. Reaction of mixtures of two bases with an acid indicate that specific, strong interactions can occur between ion pairs containing different cations. Author

N64-29946 Bureau of Mines, Albany, Ore. Albany Metallurgy Research Center
PREPARATION OF ALUMINUM FLUORIDE FROM ALUMINA HYDRATE AND DILUTE FLUORIDE SOLUTIONS
Henry E. Blake, Jr. and Robert K. Koch 1964 21 p refs
(BM-RI-6524)

Laboratory tests were made to determine if aluminum fluoride of commercial grade could be synthesized by reacting alumina hydrate with dilute (25 to 75 g/liter of fluorine) aqueous fluoride solutions. Products containing up to 90% aluminum fluoride (AlF_3) were synthesized by reaction of alumina trihydrate ($Al_2O_3{\cdot}3H_2O$) with either dilute hydrofluoric acid (HF) or ammonium fluoride (NH_4F) solutions, the ammonium fluoride solution resulting from ammonia (NH_3) desilication of a hydrofluoric–fluosilicic acid (HF-H_2SiF_6) solution. Fluorine recoveries of over 80% were obtained with either type of solution. The hydrated precipitates of AlF_3 and $(NH_4)_3AlF_6$ (ammonium aluminum fluoride) obtained by reacting hydrated alumina with these solutions were subsequently converted to anhydrous AlF_3 by controlled heating. Author

N64-29965 Radio Corp. of America, Lancaster, Pa. Electronic Components and Devices
IMPROVED ELECTROLUMINESCENT PHOSPHORS Final Report
S. A. Harper Griffiss AFB, N.Y., Rome Air Develop. Center, Aug. 1964 111 p refs
(Contract AF 30(602)-2917)
(RADC-TDR-64-159; AD-605261)

This report describes the results of studies on the performance characteristics of electroluminescent (EL) zinc sulfoselenide phosphor powders in plastic dielectrics. The objective of this investigation was to develop phosphors that yielded exceptional brightness under pulsing conditions, as well as improved performance under continuous excitation at both high and low voltages. Phosphors were evaluated under short bursts of a.c. (pulsed) excitation with the frequency within the pulse varying from 20 to 100 kc. About 5,000 ft L of brightness was obtained during pulse intervals, and maximum bursts were measured close to 10,000 ft L. Under continuous excitation at 420 cps, three selected phosphors emitting in the green–yellow, light yellow, and deep yellow region displayed initial brightnesses of about 97, 60, and 33 ft L. The maintenance (hours to one-half of initial brightness) of these same layers was about 2,200, 4,500, and 8,000 hr, respectively. Author

N64-30011 Ohio State U. Research Foundation, Columbus
EMISSION SPECTRUM OF NITRIC OXIDE IN THE NEAR INFRARED Scientific Report No. 2
Eugene Franklin Horn (Ph.D. Thesis) May 1964 113 p refs
(Contract AF 19(604)-6150)
(AFCRL-64-583; AD-604445)

The nitric oxide emission spectrum of the vibration-rotation bands of the electronic ground state has been observed in the 1.83μ to 1.95μ and 2.63μ to 2.81μ regions. A high-tension discharge through NO at reduced pressure was utilized as the source. The 2.69μ, 2.73μ, and 2.77μ bands were analyzed in detail and accurate values of the vibrational and rotational constants and the spin-orbit coupling constant A are presented. A calibration procedure utilizing atomic spectral lines was developed for use with the high-resolution grating spectrometer employed in the study. A detailed analysis of the applicability of the procedure is presented. Author

N64-30032 Pennsylvania State U., University Park
A QUANTITATIVE SCALE OF ELECTRON ACCEPTOR STRENGTHS FROM F-NMR
Robert W. Taft and J. W. Carten Jul. 1964 8 p refs Submitted for Publication
(Contract Nonr-656(31))
(TR-1; AD-602393) OTS: $1.00

Shielding of the fluorine atom in a p-fluorophenyl derivative, $p\text{-}FC_6H_4X$, is a highly sensitive measure of the power of the group X to contribute or withdraw electronic charge from the benzene ring in its ground electronic state. To reflect the strength of this interaction and make use of this physical measurement as an "intrinsic" scale of acceptor strengths with useful chemical applications, p-fluorobenzonitrile (FBN) was used as the donor molecule for interaction with a series of electron acceptors (Lewis acids). Results, given in tabular and graphic form, confirm the potential of the method. A.W.

N64-30035 Georgia U., Athens
CHEMICAL AND ENZYMATIC STUDIES ON THE CONVERSION OF CHEMICAL ENERGY TO LIGHT Final Technical Report

G. E. Philbrook Jun. 1964 25 p
(Grants AF-AFOSR-62-73; AF-AFOSR-44-63)
(AFOSR-64-1271; AD-602798) OTS: $1.00

Research in the following areas is reported: (1) studies of methods for preparing and purifying luminol and its analogs; (2) the discovery of the chemiluminescence of indole and certain of its derivatives; (3) attempts at the preparation of cinnolines in order to determine whether or not these compounds were chemiluminescent; (4) studies of the action of chlorine dioxide as an oxidizing agent; and (5) the study of the chemiluminescence of lophine and its derivatives. A paper entitled "The Chemiluminescence of Indoles," by G. E. Philbrook, J. B. Ayers, and J. R. Totter, is presented in the appendix. I.v.L.

N64-30038 Tennessee Valley Authority, Wilson Dam, Ala. Div. of Chemical Development
HEATS OF FORMATION OF PHOSPHORUS OXIDES Progress Report, Dec. 1, 1963–May 31, 1964
E. P. Egan, Jr. and B. B. Luff 13 Jul. 1964 17 p refs
(Contract CMLMC-PA-2B-RFP-129)
(AD-442826)

The heat of formation, from the elements at 25° C, of liquid $POCl_3$ was measured in a solution calorimeter on the basis of the overall reaction $POCl_3$ (liq) + $3H_2O$(liq) → H_3PO_4(c) + 3HCl(g). Since it was not practical to use crystalline H_3PO_4 and gaseous HCl as reactants, aqueous solutions of these compounds were used with appropriate thermal corrections. The preparation of reagents, the solution calorimeter, and the measurement of temperature are described. The measured heats of reaction in the solution calorimeter and published heats of formation of the reagents and products were used to calculate the heat of formation of the liquid $POCl_3$. This was found to be −80.2 ± 0.2 kcal/mole. I.v.L.

N64-30095* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
COMPARISON AND EVALUATION OF SEVERAL CHEMICALS AS AGENTS FOR ROCKET-VEHICLE PRODUCTION OF SMOKE TRAILS FOR WIND-SHEAR MEASUREMENTS
Wade E. Lanford, Joseph J. Janos, and Hal T. Baber, Jr. Washington, NASA, Sep. 1964 29 p refs
(NASA-TN-D-2277) OTS: $0.75

An investigation was made to determine the relative merits of four smoke-producing chemicals. Results of ground tests of one chemical and flight tests of three others are presented. These three chemicals are evaluated with regard to brightness and persistence interval of trails produced under identical conditions and, also, with regard to operational and handling considerations. Relative humidity and other effects on the trail are also discussed. These tests also verify the assumption that response of a smoke trail to wind movement is nearly perfect. Author

N64-30106 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ORGANIC SILICON COMPOUNDS WITH PHENYLENE- AND THIENYLENE-CHAIN LINKS
T. I. Tschernyschewa, N. S. Nametkin et al 17 Jul. 1964 7 p
Transl. into ENGLISH from Plaste Kautschuk (Leipzig), v. 10, no. 7, 1963 p 390–391
(FTD-TT-64-165/1+2; AD-603327)

Reactants, conditions, and properties of products are given for a number of synthetic reactions producing silicon-linked polymers. Grignard reactions were important steps in the production of dihydrothienylenesilane, dihydrophenylenesilane, p-phenylenevinylhydrosilanes, and 2,5-vinylhydrothienylsilanes. The latter two polymerize under platinum catalysis to form silicon–phenylene–silicon–alkyl or silicon–thienylenesilicon–alkyl chains. Infrared spectra were used to characterize the polymers. D.E.W.

N64-30126 Argonne National Lab., Ill.
ANION EXCHANGE CHARACTERISTICS OF THE ELEMENTS IN NITRIC ACID AND NITRATE SOLUTIONS AND APPLICATION IN TRACE ELEMENT ANALYSIS
J. P. Faris and Robert F. Buchanan Jul. 1964 32 p refs
(Contract W-31-109-ENG-38)
(ANL-6811) OTS: $0.75

The adsorption of most metal ions onto a strongly basic anion exchange resin from nitric acid solution has been determined. Distribution coefficients are given for some 70 elements in acid concentrations ranging from 0.1 M to 14 M. The increased absorption of some elements from nitrate solutions of low acidity offer additional possibilities for analytical separations by anion exchange resins. Some analytical procedures are outlined whereby trace impurities were concentrated by anion exchange in a nitrate medium and then determined by an emission spectrographic technique. Methods developed for the analysis of thorium, plutonium, and neptunium have utilized the large separation factors from most other ions in a nitric acid medium; differences in adsorption from methanol-nitric acid mixtures have been applied to the analysis of the rare earths. Author

N64-30128 Iowa State U. of Science and Tech., Ames Ames Lab.
BASE HYDROLYSIS OF TRANS-DICHLORODIAMINE-PLATINUM (II)
Ronald George Gunther and D. S. Martin Jun. 1964 56 p refs
(Contract W-7405-ENG-82)
(IS-883) OTS: $1.50

The reactions

$$\underline{t}\text{-}[Pt(NH_3)_2Cl_2] + OH^- \rightleftarrows \underline{t}\text{-}[Pt(NH_3)_2Cl(OH)] + Cl^- \text{ and}$$
$$\underline{t}\text{-}[Pt(NH_3)_2CL(OH)] + OH^- \rightleftarrows \underline{t}\text{-}[Pt(NH_3)_2(OH)_2] + CL^-$$

in aqueous solutions were studied by measuring the changes in specific conductivity and in ultraviolet absorption that occurred during the course of the reactions. The rates of reaction were determined from a plot of ln L(t) vs time, where L(t) is either (optical density at infinite time)–(optical density at time t) for the spectrophotometric determinations or (conductivity at time t)–(conductivity at infinite time) for the conductometric experiments. The conductometric experiments also required correction for hydroxide attack upon the measuring vessel. Both reactions were found to be zero order in hydroxide, to be the only reactions occurring between the platinum complex and the hydroxide for times up to one day, and to involve the formation of an aquo intermediate. Author

N64-30129 Bureau of Mines, Boulder City, Nev. Metallurgy Research Lab.
ALUMINUM EXTRACTION CHARACTERISTICS OF THREE CALCIUM ALUMINATES IN WATER, SODIUM HYDROXIDE, AND SODIUM CARBONATE SOLUTIONS
R. V. Lundquist and H. Leitch 1964 20 p refs
(BM-RI-6528)

The solubility characteristics of three calcium aluminates, $12CaO{\cdot}7Al_2O_3$, $3CaO{\cdot}Al_2O_3$, and $4CaO{\cdot}Al_2O_3{\cdot}Fe_2O_3$, were determined in water and in solutions of NaOH and Na_2CO_3 to more clearly define their role in relation to the recovery of

aluminum by the lime sinter and the lime-soda sinter processes. The calcium aluminates were prepared by sintering stoichiometric mixtures of $CaCO_3$, $Al_2O_3 \cdot 3H_2O$, and Fe_2O_3 at 1,375° C. The rates and extent of aluminum extractions were determined. The aluminum extractions from the aluminates were dependent on the presence of carbonate ions in the leach solutions, temperature, time, leach solution composition, and solid–liquid ratio of the slurry. The aluminum extracted from the calcium aluminates in water and in NaOH solutions varied from 4.6 to 22.9 percent. Virtually complete extraction could generally be obtained for $12CaO \cdot 7Al_2O_3$ and $4CaO \cdot Al_2O_3 \cdot Fe_2O_3$; in one instance it was obtained for $3CaO \cdot Al_2O_3$, when an excess of carbonate ions was present over that required for the conversion of all of the calcium in the aluminates into $CaCO_3$. Author

N64-30134 Naval Research Lab., Washington, D.C. Dielectrics Branch
PREPARATION AND CHARACTERIZATION OF ULTRA-PURE SOLIDS Quarterly Report, 31 Dec. 1963–30 Jun. 1964
J. H. Schulman [1964] 8 p
(ARPA Order-418)
(QR-4; AD-443666)

Zone refining apparatus for the preparation of longer ingots, having improved control of molten zone movement and zone width, has been constructed. Additional zone refining purification of KCl and KBr is described. Other work has been done on the growth of alkali halide crystals, chemical purification using Bio-Rad ZP-1 inorganic ion exchanger, comparison of a.c. and d.c. conductivity measurements, and the evaluation of methods of chemical analysis. R.L.K.

N64-30140 Maremont Corp., Pasadena, Calif. Research and Development Labs.
STUDY OF ROCKET ENGINE EXHAUST PRODUCTS Quarterly Report No. 11, 1 Dec. 1963–29 Feb. 1964
M. A. Greenbaum, R. E. Yates, J. A. Blauer, M. Arshadi, H. C. Ko et al [1964] 16 p refs
(Contract AF 04(611)-7414)
(QR-7414-11; AD-600280)

The study of the reaction: $BF_3(g) + 2B(s) = 3BF(g)$ has been completed. The second and third law values for ΔH_{f298} for BF(g), in excellent agreement, are, respectively, -29.0 ± 2.6 and -28.6 ± 0.5 kcal/mole. The entropy, $S_{298}0$, obtained from this study is 47.6 ±1.9 cal/deg/mole, which compares with the theoretical value of 47.9 cal/deg/mole. Studies of the $BeO(s)-H_2O(g)$ reaction and $AlF_3(g)-Al(l)$ reaction are continuing and are near completion. Investigation of the $MgCl_2(g)-Al(l)$ reaction has commenced, and apparatus for the study of the dissociation energy of $F_2(g)$ is under construction. Author

N64-30149 United States Rubber Co., Naugatuck, Conn. Chemical Div.
SYNTHESIS OF REGULATED STRUCTURE POLYPHENYL-ETHER–SILOXANE BLOCK COPOLYMERS Terminal Report, 1 Jul. 1961–15 Jan. 1964
Robert Mac Farlane, Jr. and Eugene S. Yankura [1964] 34 p refs
(Contract DA-19-020-ORD-5507)
(AP-600121)

Several block copolymers have been prepared that possess excellent thermal stability and radiation resistance. The practicality of the reasoning leading to these polymers has been demonstrated conclusively. The major deficiency of these polymers is in their low-temperature properties and their solubility behavior, rather than in their high-temperature properties. Procedures have been established that allow efficient preparation of the dihydroxy substituted phenyl ethers needed for the copolymers of this report. Preparation methods for various isomers of the monomer are described, and recommended future work is listed. D.E.W.

N64-30157 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ELECTROCHEMICAL AND CORROSION BEHAVIOR OF STEEL AND NICKEL ELECTRODES IN SOLUTIONS OF SULFURIC ACID, SUBJECTED TO A REACTION OF γ-RADIATION
Ya. Kolotyrkin, N. Ya. Bune, and G. S. Tyrulkov 6 Dec. 1963 12 p refs Transl. into ENGLISH from Vses. Soveshch. Radiats. Khim., AN SSSR, Otdel Khim. Nauk (Moscow), v. 1, 1958 p 143–149
(FTD-MT-63-126; AD-602556)

The electrochemical and corrosion behavior of stainless steel and nickel in 1.0 N solutions of H_2SO_4 subjected to Co^{60} gamma radiation of 1.5 X 10 ev/ml-sec was investigated. The change in potential of both activated and air-oxidized steel electrodes with irradiation time is plotted; in all cases radiation resulted in displacement of the potential toward positive values. The rate of corrosion decreased considerably from the rate of corrosion in the absence of radiation. A relationship is developed for estimating the rate of corrosion on the basis of the magnitude of the potential, and it is concluded that the radiation effect on a steel electrode is equivalent to the polarization of its anodic current. Gamma radiation also resulted in displacement of the potential of nickel electrodes toward positive values, but the magnitude of displacement remained small, and the rate of corrosion increased 2 to 3 times. These results indicate that the corrosion behavior of metals in irradiated aqueous solutions depends to a significant degree on their capability for passivation. M.P.G.

N64-30201 Dow Chemical Co., Midland, Mich. ARPA Lab.
MASS SPECTRAL STUDIES OF KINETICS BEHIND SHOCK WAVES. I: THERMAL DISSOCIATION OF CHLORINE
R. W. Diesen and W. J. Felmlee Aug. 1963 21 p refs
(Contract Nonr-3814(00))
(DOW-AR-2S-63; AD-414941)

The coupling of a shock tube to a time-of-flight mass spectrometer for the determination of kinetic data is described whereby analysis is performed every 25 μsec. The rate of dissociation of Cl_2 has been measured over the temperature range 1,700° to 3,200° K under essentially isothermal and isobaric conditions with the observed rate constants in fair agreement with those obtained by the spectroscopic technique. The observed temperature dependence is less than predicted by simple collision theory, with an apparent activation energy of 41 ±5 kcal/mole. Author

08 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; telemetry; tracking; and wave propogation. *For tracking stations see*: 10 Facilities, Research and Support. *For related information see*: 06 Auxiliary Systems; 09 Electronics; 15 Instrumentation and Photography; and 22 Navigation and Guidance.

N64-29025 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

ASYMPTOTIC ESTIMATES OF THE ERROR PROBABILITY FOR THE TRANSMISSION OF MESSAGES THROUGH A DISCRETE MEMORYLESS COMMUNICATION CHANNEL WITH A SYMMETRIC MATRIX OF TRANSACTION PROBABILITIES

R. L. Dobrushin 3 Jul. 1963 50 p refs Transl. into ENGLISH from Teoriya Veroyatnostei i ee Primeneniya (Moscow), v. 7, no. 3 1962 p 283–311

(FTD-TT-63-543/1+2+4; AD-413329)

Asymptotic estimates are derived of the error probability for the transmission of messages through memoryless channels, for which all conditions at the input and all conditions at the output are equivalent. More accurately speaking, a stochastic matrix shall be called symmetric if any of its rows are obtained by a certain permutation of the elements of any other row, and if any of its columns are obtained by a certain permutation of the elements of another column. Only channels with a symmetric transaction-probability matrix are considered; a symmetric binary channel is an example of such a channel. In addition, the case of degenerate channels is considered. I.v.L.

N64-29061 Radio Corp. of America, Camden, N.J. Defense Electronic Products

DOPPLER OPTICAL NAVIGATOR First Quarterly Progress Report

W. J. Hannan, L. J. Nicastro, and C. W. Reno 19 Sept. 1963 63 p refs

(Contract AF 33(657)-11458)

(QPR-1; AD-420000)

Analysis of overall performance of the doppler optical navigation system, taking into account solar background noise, atmospheric attenuation and typical operational requirements, leads to the conclusion that required transmitter power is considerably greater than the power available from currently available lasers. Developments that promise to reduce required transmitter power are described. The "coherence" gain afforded by amplitude modulation of the optical carrier wave is also analyzed. It is concluded that amplitude modulation not only simplifies the doppler detection circuits but also increases the fractional intensity of the doppler signal component. Measured stability of the He-Ne gas laser indicates that it is just about stable enough to provide a velocity measurement accuracy of 5 m/sec. Author

N64-29101 Air Force Missile Test Center, Patrick AFB, Fla. Directorate of Data Processing

A COMPILATION OF PAPERS PRESENTED AT THE FIFTH JOINT AFMTC/RANGE USER DATA CONFERENCE

Marvin J. Woodring, ed. 15 Apr. 1964 473 p refs Conf. held at USAF Conf. Facility, Orlando AFB, Fla., 18–19 Mar. 1964

(MTC-TDR-64-5; AD-600091)

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15. RADAR SIGNATURE PROCESSING AT AMR R. J. Pepple, Jr. (RCA) p 345–380 (N64-29114 21-08)

16. THE GLOTRAC DATA ADJUSTMENT PROGRAMS J. W. Stephenson (RCA) p 381–408 (See N64-29115 21-08)

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19. NEW REAL TIME COMPUTER FACILITY G. N. Spears (RCA) p 475–494 (See N64-29118 21-08)

N64-29102 National Academy of Sciences-National Research Council, Washington, D.C. Panel on Tracking Data Analysis

COMMENTS ON THE AMR ACCURACY PROBLEM Keynote Address

Samuel S. Wilks (Princeton U.) *In its* AF Missile Test Center A Compilation of Papers Presented at the 5th Joint AFMTC/Range User Data Conf. 15 Apr. 1964 p 19–33 (See N64-29101 21-08)

The problem of improving accuracy in the measurement of missile trajectories from tracking systems at the Atlantic Missile Range has many facets. Specifications for accuracy are at the limit of state-of-the-art of making position and velocity measurements; geodetic and electromagnetic transmission errors are increasingly serious; calibration methods can no longer be based on external standards, but must allow the tracking systems to calibrate themselves. There has been a slower development of high-grade tracking facilities in the reentry area; several possibilities for obtaining adequate amounts of reentry tracking data are suggested. Funding and procurement is an aspect in which longer-range planning is called for. The data-processing load is rapidly increasing, and must be controlled. Another area of possible future improvement is that of specifying tracking accuracies to meet the range users' needs. R.L.K.

N64-29103 Air Force Missile Test Center, Patrick AFB, Fla.
THE GLOBAL RANGE—1964 AND BEYOND
W. S. Hines *In its* A Compilation of Papers Presented at the 5th Joint AFMTC/Range User Data Conf. 15 Apr. 1964 p 35–47 (See N64-29101 21-08)

The author expects a gradual evolution of the global range, starting with the existing network of stations and adding instrumentation as necessary. The key to successful global operations is effective network control; therefore, the communications that interconnect the many stations must be adequate and reliable enough to permit rapid switching from one type of operation to another. Instrumentation meeting minimum requirements for range support has been developed, but there is much work still to be done in areas of equipment improvement, consolidation, and standardization. R.L.K.

N64-29104 Space Technology Labs., Los Angeles, Calif.
THE DETERMINATION OF TRACKING SYSTEM REQUIREMENTS AND THE DESIGN OF AN OPTIMIZED TEST REGIME FOR EVALUATING BALLISTIC MISSILE INERTIAL GUIDANCE SYSTEMS IN FLIGHT TEST
Alvin N. Drucker *In* AF Missile Test Center A Compilation of Papers Presented at the 5th Joint AFMTC/Range User Data Conf. 15 Apr. 1964 p 49–82 refs (See N64-29101 21-08)

An analytical method is presented for dealing with two problems that arise when it is necessary to plan a guidance-system test program. These are the problems of properly specifying the tracking-accuracy requirements so that the range provides the necessary data to achieve the guidance-system test objectives, as well as the problem of selecting the optimum trajectory, optimum guidance-system orientation, optimum tracking geometry, and optimum data-processing effort, which, within the trajectory, equipment, and schedule constraints imposed by the test program, provides the greatest amount of guidance-system test information per test dollar expended. The manner in which tacking-system accuracy specifications originate is reviewed. R.L.K.

N64-29105 Radio Corp. of America, Patrick AFB, Fla.
ORBIT DETERMINATION
J. R. Garrett *In* AF Missile Test Center A Compilation of Papers Presented at the 5th Joint AFMTC/Range User Data Conf. 15 Apr. 1964 p 83–108 refs (See N64-29101 21-08)

Several practical methods of computing the orbit and ephemeris of a near-earth satellite are presented, along with the means of improving these results. The objective of the computation is to determine the location and velocity of an orbiting body with respect to some coordinate system, as a function of time. The orbit can be expressed in the form of a tabular listing of coordinates and velocity components versus time (an ephemeris). This table may be constructed by integrating the equations of motion with the constants of integration, determined initially and adjusted at intervals by means of observations. R.L.K.

N64-29106 Radio Corp. of America, Patrick AFB, Fla.
GENERAL DATA ANALYSIS WITH INERTIAL GUIDANCE DATA AS THE REFERENCE
H. P. Mann *In* AF Missile Test Center A Compilation of Papers Presented at the 5th Joint AFMTC/Range User Data Conf. 15 Apr. 1964 p 109–144 (See N64-29101 21-08)

Comparisons of inertial-guidance data with range-tracking data are made on all Minuteman and Titan flights. These comparison data are used for purposes of detecting anomalies in the external tracking data and of estimating the precision of the tracking information. The merit of such comparisons lies in the inherently different frequency characteristics of the errors of the two systems; these differences allow the systems to reveal the nature of the error in each other. The inertial-guidance data may be used, therefore, as a standard for the determination of noise in the external data, whereas the external data, in turn, are used as a standard for the determination of long-term drift or bias error in the guidance data. These comparison data form the nucleus of that referred to as a general data analysis. R.L.K.

N64-29107 Radio Corp. of America, Patrick AFB, Fla.
ATLANTIC MISSILE RANGE GEODETICS
J. P. Lushene *In* AF Missile Test Center A Compilation of Papers Presented at the 5th Joint AFMTC/Range User Data Conf. 15 Apr. 1964 p 145–167 (See N64-29101 21-08)

Accuracy tests were designed, and data were analyzed employing the ballistic technique of phototriangulation to determine geodetic positions. In this technique, a strobe light or flares are photographed against a star background. The spatial position of the light image is determined by cameras on a known baseline; the camera at the unknown station will determine its camera orientation to the spatial point and, thereby, its geodetic position. This procedure is termed space resection. R.L.K.

N64-29108 Radio Corp. of America, Patrick AFB, Fla.
PULSE RADAR PERFORMANCE EVALUATIONS
A. E. Hoffman-Heyden *In* AF Missile Test Center A Compilation of Papers Presented at the 5th Joint AFMTC/Range User Data Conf. 15 Apr. 1964 p 169–201 (See N64-29101 21-08)

Subjects presented are concerned with evaluations conducted to solidify knowledge of the accuracies of the AN/FPS-16 radars under operational conditions, the MIPIR radar acceptance-test evaluations, accuracy and operational performance of the MIPIR radars, and the more recent examinations of radar accuracy by means of residuals from orbital trajectories. R.L.K.

N64-29109 Radio Corp. of America, Patrick AFB, Fla.
ADVANCED RANGE INSTRUMENTATION SHIPS—EVALUATION STATUS
T. T. Williams and M. A. King *In* AF Missile Test Center A Compilation of Papers Presented at the 5th Joint AFMTC/Range User Data Conf. 15 Apr. 1964 p 203–233 (See N64-29101 21-08)

Advanced Range Instrumentation Ships (ARIS) were developed to meet the need for signature and trajectory information independent of an outside navigation reference. The instrumentation and operation of these ships are described. With the objectives of establishing the accuracy of signature calibration, of deriving trajectory accuracy, of evaluating navigation subsystem accuracies, and of establishing the accuracy of the video recorders, tests were designed, and data were collected. The techniques of analysis applied to the test results, the level of testing accomplished to date, and the results of these tests are described. R.L.K.

N64-29110 Radio Corp. of America, Patrick AFB, Fla.
MISSILE IMPACT LOCATING SYSTEM/BROAD OCEAN AREA (MILS/BOA) POST-TEST CALIBRATION
L. R. Whitehead *In* AF Missile Test Center A Compilation of Papers Presented at the 5th Joint AFMTC/Range User Data Conf. 15 Apr. 1964 p 235–259 (See N64-29101 21-08)

The system consists of signal receivers (hydrophones), shore-connecting cables, amplifiers, time standards, recorders, and necessary calibration and maintenance equipment. Operationally, the BOA hydrophones detect signals generated by an explosion (SOFAR charge) carried by a missile reentry body. The reentry body impacts in the ocean, sinks, and the charge is detonated at a specific depth (known as the sound-channel axis). The specific time of arrival of the signal at each hydrophone is determined. By having prior knowledge of the position of each hydrophone and the velocity of propagation of the energy through the ocean, the location and time of explosion of the source can be determined. These solutions are obtained by a least-squares adjusted, iterative, hyperbolic triangulation computational scheme. R.L.K.

N64-29111 Radio Corp. of America, Patrick AFB, Fla.
MISTRAM DATA PROCESSING
John W. Stephenson *In* AF Missile Test Center A Compilation of Papers Presented at the 5th Joint AFMTC/Range User Data Conf. 15 Apr. 1964 p 261–281 (See N64-29101 21-08)

The MISTRAM (Missile Trajectory Measurement System) measures the trajectory of a missile by recording its position as a function of time. The velocity, acceleration, and any other desired derivatives of the motion can be formed numerically from these position measurements. The principles of operation, the systematic and random errors, and the sequence of operations in the data processing are described. R.L.K.

N64-29112 Radio Corp. of America, Patrick AFB, Fla.
MISTRAM ACCURACY
John A. Greene *In* AF Missile Test Center A Compilation of Papers Presented at the 5th Joint AFMTC/Range User Data Conf. 15 Apr. 1964 p 283–311 (See N64-29101 21-08)

The major MISTRAM errors are primarily of the bias type, i.e., constant over a particular time interval. The second most important error is residual refraction, and is most critical at low elevation angles. Two-foot ambiguities have been detected in the final published data in Range, P_2, and Q_2 for many past tests. Studies have shown that the MISTRAM position data can be corrected to near specification values by a new error model maximum likelihood program (GLAD), when simultaneous data are available from MISTRAM I and MISTRAM II. This program determines the coefficients in the MISTRAM error model and corrects the final data. Author

N64-29113 Radio Corp. of America, Patrick AFB, Fla.
REDUCTION OF OPTICAL SIGNATURE DATA FROM THE OUTPUT OF CINE-SPECTROGRAPHS
John Rollins, Jr. *In* AF Missile Test Center A Compilation of Papers Presented at the 5th Joint AFMTC/Range User Data Conf. 15 Apr. 1964 p 313–343 (See N64-29101 21-08)

Radiation emitted by the interactions and heating of missile tankage, reentry, vehicles, space capsules, penetration aids, etc., when reentering the earth's atmosphere, is collected by cine-spectrographs. The developed film is "read" on a digital output microdensitometer, and the density of the emulsion is recorded onto magnetic tape as a function of its position on the film. The techniques for the calibration of the spectrographs and the methods for calculation of the spectral irradiance, apparent spectral radiant intensity, and the spectral radiant intensity are discussed. Using these parameters, an experienced analyst can estimate the surface temperature, the emissivity-area product, scintillation and ablation rates, and can identify materials in the object under investigation. R.L.K.

N64-29114 Radio Corp. of America, Patrick AFB, Fla.
RADAR SIGNATURE PROCESSING AT AMR
Royal J. Pepple, Jr. *In* AF Missile Test Center A Compilation of Papers Presented at the 5th Joint AFMTC/Range User Data Conf. 15 Apr. 1964 p 345–380 (See N64-29101 21-08)

Radar-signature reductions are described for two AMR radar-instrumentation systems—the ARIS ships and the FPS-43 in Trinidad. The processing is designed to present the signature information in a standardized format; that is, the characteristics of the measuring system are removed or calibrated, and the data is processed relative to standard quantities. The details of the calibration procedures are given for each system. R.L.K.

N64-29115 Radio Corp. of America, Patrick AFB, Fla.
THE GLOTRAC DATA ADJUSTMENT PROGRAMS
John W. Stephenson *In* AF Missile Test Center A Compilation of Papers Presented at the 5th Joint AFMTC/Range User Data Conf. 15 Apr. 1964 p 381–408 (See N64-29101 21-08)

The GLOTRAC System is designed to provide precise and accurate global tracking of missiles and space vehicles. Its accuracy is dictated by the performance of the equipment, the geographical locations of the various receiving and transmitting sites, and, as particularly covered here, the data-processing method around which the system is designed. The GLOTRAC relies upon the data processing to determine the necessary constants of integration or system biases. This is particularly important from the point of view of reliability; i.e., since the bias determination is performed after the flight, results are not strictly dependent upon the operation, during the flight, of an electronic calibration system whose failure could invalidate all system data. There is a definite cost advantage involved, as experience has shown that electronic equipment designed to perform this function is highly complicated and expensive. R.L.K.

N64-29116 Pan American World Airways, Inc., Patrick AFB, Fla.
REFRACTION PROBLEMS ON THE AMR
Charles L. Carroll, Jr. *In* AF Missile Test Center A Compilation of Papers Presented at the 5th Joint AFMTC/Range User Data Conf. 15 Apr. 1964 p 409–456 refs (See N64-29101 21-08)

The most significant and practical tropospheric refraction problems for electromagnetic systems are these: (1) the determination of the ultimate limitations imposed by nature on electronic tracking systems by the troposphere; (2) the determination of optimum methods for correcting data from electronic tracking systems for the effects of tropospheric refraction; (3) estimating the magnitude of the uncorrected residuals due to the tropospheric refractions, using optimum methods for correction; (4) the development of methods for forecasting the magnitude of uncorrectable residuals for specific meteorological conditions; and (5) the development of real-time methods of correcting tropospheric refraction. The status of research on these problems at several locations is described. Three basic approaches to refraction correction are discussed. R.L.K.

N64-29117 Radio Corp. of America, Patrick AFB, Fla.
THE DATA REDUCTION COMPUTER SYSTEM AT THE ATLANTIC MISSILE RANGE
William J. Kirklin *In* AF Missile Test Center A Compilation of Papers Presented at the 5th Joint AFMTC/Range User Data Conf. 15 Apr. 1964 p 457–473 (See N64-29101 21-08)

The POD (Process on Demand) computer system is designed to reduce the data-reduction cycle by minimizing, or eliminating completely, data retrieval (off-line), program retrieval, frequent paper changing, setup times, and manual batching. Major components of the system are high-speed printers, IBM-7040 acting as central exchange for all data, IBM-7094, IBM-1401, and IBM-1301 Disk—a large random access storage device capable of retaining all programs and sufficient data, accessible by the computer without interfering with the central processor and capable of receiving data from all possible sources of raw data and of sending data to printers and/or magnetic tape, again without interfering with the operation of the central processor. R.L.K.

N64-29118 Radio Corp. of America, Patrick AFB, Fla.
NEW REAL TIME COMPUTER FACILITY
Gary N. Spears *In* AF Missile Test Center A Compilation of Papers Presented at the 5th Joint AFMTC/Range User Data Conf. 15 Apr. 1964 p 475–494 (See N64-29101 21-08)

The Real Time Computer System consists of two Control Data 3600 computers, together with associated input–output equipment that is described in detail. The impact point of a missile will be predicted in real time for the primary purpose of range safety. R.L.K.

N64-29188* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EGO BALLOON EXPERIMENT DATA PROCESSOR
Paul Heffner and John Cole May 1964 41 p refs
(NASA-TM-X-55068; X-544-64-138) OTS: $4.60 ph

The EGO balloon experiment data processor is designed to operate on prelaunch data for the EGO series satellites: specifically, experiments Mark II, Mark III, and Mark IV. These experiments, carried by balloon flights into the upper atmosphere, provide experimental data concerning identification of particles and measurement of their energies, which are recorded on magnetic tape. Upon retrieval of the recorded tapes, the EGO data processor serves as a quick-look facility in the field by processing samplings of the data throughout each tape, converting each sampling to decimal form for both decimal display and decimal printout. Author

N64-29190* Alabama U., University Bureau of Engineering Research
MULTIFREQUENCY ANTENNA BREAKDOWN Interim Report, 5 Jun. 1963–4 Jun. 1964
Harold Mott Jun. 1964 58 p refs
(Contract NAS8-5412)
(NASA-CR-58309) OTS: $5.60 ph

The results of a theoretical and experimental investigation of high-altitude antenna voltage breakdown during the radiation of multiple signals from one antenna system are presented. The experimental and theoretical work of other investigators is reported and applied to the problem of multifrequency breakdown. Maximum and minimum breakdown power limits are developed theoretically. Measurements of two- and three-frequency breakdown power are discussed. Author

N64-29191* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A GENERAL LEAST SQUARES FORMULATION FOR TRACKING SYSTEM ACCURACY ANALYSIS—WITH APPLICATION TO THE WOOMERA STATION DATA OF MA-6 MISSION Plans Office Technical Report No. 7
Howard H. Brown 1 Nov. 1962 66 p refs
(NASA-TM-X-55048; X-520-62-222) OTS: $6.60 ph

A general least-squares procedure is formulated for the analysis of a tracking system's accuracy, based on examination of the range, azimuth, and elevation outputs of the tracking system. The least-squares process for calculating the standard deviations of range errors, azimuth errors, and elevation errors is presented. Also included is a process for calculating the standard deviations of range-rate errors, azimuth-rate errors, and elevation-rate errors for a system in which range rate, azimuth, and elevation rate are computed from the time derivatives of the corresponding least-squares polynomials used to fit range, azimuth, and elevation. P.V.E.

N64-29192* Control Data Corp., Minneapolis, Minn. Computer Div.
RADIO FREQUENCY INTERFERENCE TEST REPORT. CONTROL DATA CORPORATION 924-A COMPUTER SYSTEM
Pierre Delaby 29 Jun. 1964 67 p
(NASA-CR-58235; RFI-1) OTS: $6.60 ph

This report presents the procedures and results of radiated and conducted electromagnetic interference tests performed on a Control Data Corporation 924-A Computer System. These tests were performed according to military specification Mil.-I-6181D, with the exceptions and/or additions as delineated in the attached test plan. The results indicate that the computer system does not meet the specifications by the amounts indicated on graphs. Author

N64-29198* Massachusetts Inst. of Tech., Cambridge Research Lab. of Electronics
A STUDY OF THE PERFORMANCE OF LINEAR AND NONLINEAR FILTERS
Vidal R. Algazi (Ph.D. Thesis) 22 Jun. 1964 110 p refs
(Grants NsG-496; NIH MH-04737-04; NSF GP-2495; DA-SIG-36-039-61-G14; Contract DA-36-039-AMC-03200(E))
(NASA-CR-56838; TR-420) OTS: $9.10 ph

A measure of the performance of filters is proposed that compares the filter under study to an optimum attenuator acting on the same input. The noise level (noise-to-message power ratio) is emphasized as an independent parameter important to the behavior and the performance of both linear and nonlinear filters. For optimum and nonoptimum linear filters, the effect of the noise level on the performance is the specific object of study. For nonlinear no-memory filters, after considering the determination of the optimum filter for mean-square and non-mean-square criteria, the characteristics of the message and the noise for which the optimum mean-square filter reduces to an attenuator are investigated. As expected, Gaussian message and Gaussian noise will give such a filter but there are many other cases, some critically dependent on the noise level, for which this result occurs. At the other extreme of behavior, perfect separation by a nonlinear no-memory filter will not occur for any message of interest, and the selection of the message of a defined class that will give the smallest (or largest) average weighted error is considered. Author

N64-29203* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
JPL TRACKING DATA EDITING PROGRAM FOR THE IBM 7094
R. Holzman and C. Coltharp 1 Aug. 1964 53 p
(Contract NAS7-100)
(NASA-CR-58488; JPL-TM-33-170) OTS: $5.60 ph

The function of the Tracking Data Editing Program is to

develop formats for new tracking data so it can be handled easily by the orbit determination program. Tracking data are entered in a wide variety of formats and data types on punched cards, or card images, on magnetic tape. Flexible control cards allow the user to specify formats and data types, to correct wrong numbers, and to read in a large number of constants used in preliminary reduction of tracking data. These constants include weights, frequencies, smoothing criteria, angle corrections, and transmitter times. Control cards are also used to help the program maintain a master data file, and to select particular sets of data from the master file for the orbit determination program. Author

N64-29243 Technical Research Group, Inc., East Boston, Mass.
THE SCALAR FEED
Alan F. Kay 30 Mar. 1964 53 p refs
(Contract AF 19(604)-8057)
(AFCRL-64-347; AD-601609)

A type of wide flare feed that produces low spillover, high aperture efficiency, and broad bandwidth is described. This feed operates with no loss of its high performance characteristics over a full waveguide band (and more) and takes full waveguide power. It has low VSWR, supports linear, circular, or dual polarization, and has inherently low cross polarization. Many primary and secondary performance characteristics are described, which verify the high gain, low sidelobe, and low noise temperature features. As a tracking feed it can be used with multimode inputs, either the TE_{11} and TM_{01} mode circular guide type or the two- or four-horn monopulse type. The feed operates well in the former system but has unsolved problems in monopulse operation involving controlled mode excitation at the throat. Author

N64-29248 Army Map Service, Washington, D.C.
CALIBRATION OF MARK II MINITRACK BY PHOTOGRAPHY OF AIRBORNE FLASHING LIGHT
Howard R. Wilkerson Apr. 1964 103 p refs
(TR-48; AD-444955)

This report covers the development and use of electronic and photographic equipment for the calibration of the Army Map Service Mark II Minitrack stations. The calibration was performed by photography of an airborne flashing light, situated within the antenna used for transmission of the Minitrack signals, against a star background. Included in the report is an evaluation of the accuracy of the individual steps throughout the reduction of the calibration data, as follows: (1) the precision of plate measurement using a precision linear comparator; (2) the accuracy of the plate constants used in the solution of the light-flash positions; (3) errors in timing of events and the resulting inaccuracies of light-flash positions; and (4) deviations of measured light-flash positions from their computed positions. I.v.L.

N64-29302 Army Missile Command, Huntsville, Ala. Army Inertial Guidance and Control Lab.
SELF-TUNING ANTENNA Final Progress Report, Fiscal Year 1964
James E. Howell 28 Jul. 1964 97 p
(RG-TR-64-9; AD-446387)

This task involves the development of a self-tuning antenna that will prevent signal "drop-out" during reentry or other times of severe environmental conditions that cause detuning of the antenna. The three basic areas of investigation conducted were the logic-type self-tuning antenna, rhe servo-type self-tuning antenna, and a normalizing circuit that is a basic component of the above two antenna systems. Author

N64-29356* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
SPACE PROGRAMS SUMMARY NO. 37-28, VOLUME III FOR THE PERIOD MAY 1–JUNE 30, 1964. THE DEEP SPACE NETWORK
31 Jul. 1964 96 p refs
(Contract NAS7-100)
(NASA-CR-58556; JPL-SPS-37-28, Vol. III) OTS: $8.60 ph

The Deep Space Network (DSN) is a precision communication system that is designed to communicate with, and permit control of, spacecraft designed for deep-space exploration. The DSN consists of the Deep Space Instrumentation Facility (DSIF), the Space Flight Operations Facility (SFOF), and the DSN Ground Communication System (GCS). This report discusses the following areas relative to the DSN: (1) tracking station engineering and operations; (2) efforts of the SFOF operations group in support of Ranger and Mariner tests; (3) the development of the Goldstone duplicate standard 1964 model S-band RF system, with emphasis on a functional description of the S-band receiver, transmitter, and antenna microwave subsystem; (4) communications engineering developments—S-band implementation for DSIF and Mariner C transmitter development; (5) communications research and development—ground antennas, Venus site experimental activities, the S-band and X-band lunar–planetary radar projects, and the development of digital circuit modules; and (6) the state-of-the-art of the 210-ft-diameter advanced antenna system for the Mars site of the Goldstone Tracking Station. I.v.L.

N64-29413 Ohio State U. Research Foundation, Columbus Antenna Lab.
SURFACE WAVE PROPAGATION OVER A THIN PLASMA LAYER ON A GROUND PLANE
W. C. Y. Lee and C. H. Walter 15 Dec. 1963 61 p refs
(Contract AF 33(657)-10426)
(Rept.-1565-6; AD-441863)

A theoretical study is made of the propagation of surface waves along an infinite, perfectly conducting plane surface that is coated with a layer of plasma and subjected to an applied d.c. magnetic field. For three directions of the applied d.c. magnetic field corresponding to rectangular coordinate axes, the electric and magnetic fields are computed for the separate media, and the relations arising from boundary conditions are expressed as transcendental equations. In the limiting case of small plasma layer thickness the fields and propagation constants may be expressed in simple forms. Curves of phase velocity versus plasma thickness (c/v versus d/λ) are illustrated for the various orientations of applied magnetic field and with different plasma frequencies and cyclotron frequencies. It is found that a backward wave occurs for a certain range of plasma frequencies. Author

N64-29430 Harvard U., Cambridge, Mass. Cruft Lab.
THE IMPERFECTLY CONDUCTING CYLINDRICAL TRANSMITTING ANTENNA
Ronold N. P. King and Tai Tsun Wu 27 Mar. 1964 40 p refs
(Contract Nonr-1866(32))
(TR-440; AD-601843)

Conventionally, the contribution by ohmic resistance to the distribution of current and the impedance is contained in a particular integral that is either ignored or treated as a higher order correction to formulas derived for perfectly conducting antennas. An alternative and more useful form has been developed in which the integral equation for the current is rearranged to permit the introduction of a complex propagation constant k. An approximate solution of this equation is then obtained in terms of the three trigonometric functions, $\sin k(h - |z|)$, $\cos$

$kz - \cos k\,h$, and $\cos 1/2k_0z - \cos 1/2k_0h$ where k_0 is the free-space wave number. Expressions are derived for the coefficients of these functions and for k. Explicit formulas are given for the distribution of current and the admittance. Author

N64-29446 Stanford Research Inst., Menlo Park, Calif.
A SURVEY OF METHODS FOR TREATING ELECTROMAGNETIC SCATTERING BY RE-ENTRY WAKES
Glenn H. Keitel Jun. 1964 99 p refs
(ARPA Order-281-62; ARPA SD-103)
(TR-22; AD-445729)

Electromagnetic scattering by axially uniform cylindrical columns of ionization is examined for the homogeneous, gaussian, and parabolic electron distributions, and for the limiting case, the metallic cylinder, both for normal and off-normal incidence. The effect of turbulence in the underdense column is considered and related to the autocorrelation (or tion (or spectrum) of the turbulence. The effect of turbulence in the overdense column is approximated by a roughness on an "equivalent metallic cylinder," which permits the estimation of that component of the radar cross section. A relationship between the circular scattering coefficient of an infinite cylinder and the radar cross section of an axially varying cylinder is developed. This analysis is applied to certain typical reentry wakes resulting in estimated curves of radar cross sections as a function of frequency, aspect angle, and assumed models. Author

N64-29505* Space Technology Labs., Inc., Los Angeles, Calif.
AIRBORNE RANGE AND ORBIT DETERMINATION SYSTEM. VOLUME I: VEHICLE MASTER OSCILLATOR AND FREQUENCY SYNTHESIZER Final Report
J. E. Holland 29 Jan. 1964 175 p
(Contract NAS8-5482)
(NASA-CR-58698; Rept.-4126-6002-RU-000) OTS: $12.50 ph

The vehicle Master Oscillator and Frequency Synthesizer (MOFS) is the source of all signal frequencies required in the vehicle-borne portion of the AROD system. It is an all solid-state unit consisting of a highly stable master oscillator and appropriate coherent frequency synthesizing circuitry to drive the specified frequencies. The MOFS provides five signal-frequency outputs to the vehicle tracking transmitter, eight to the vehicle tracking receiver, five to the range-data extraction equipment, two to the frequency monitor, and one each to the vehicle command transmitter and timing unit. This report documents and summarizes the results of the entire work performed during the development, fabrication, assembly, and test of the MOFS. The report is divided into the following areas: (1) function and description of equipment; (2) theory of operation; (3) special tools and test equipment; (4) maintenance; and (5) drawings—circuit schematics and module assembly. I.v.L.

N64-29506* Space Technology Labs., Inc., Redondo Beach, Calif.
AIRBORNE RANGE AND ORBIT DETERMINATION SYSTEM. VOLUME II: VEHICLE TRACKING TRANSMITTER Final Report
8 Nov. 1963 53 p
(Contract NAS8-5482)
(NASA-CR-58699; Rept.-4126-6001-RU-000) OTS: $5.60 ph

This transmitter is an all solid-state unit that can drive a power amplifier or feed an antenna directly. The transmitted signals consist of a carrier at approximately 2,200 mHz and four ranging tones phase-modulated onto the carrier within the transmitter. The carrier is used to provide range-rate information and the tones permit the determination of the range from an orbiting spacecraft to multiple transponders located on the earth. The transmitter is normally used with the vehicle master oscillator and frequency synthesizer. The theory of operation of the transmitter, special tools and test equipment required to perform minor alignment of the device in the field, transmitter maintenance, and calibration are discussed. I.v.L.

N64-29516* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A ROUGH ESTIMATE OF THE "BLACKOUT" TIME IN RE-ENTRY COMMUNICATIONS
F. J. Tischer 19 Jun. 1962 11 p refs
(NASA-TM-X-55059; X-520-62-93) OTS: $1.60 ph

Under certain conditions, the attenuation for the underdense (u) and the overdense (o) plasma sheaths can be expressed by the following approximations:

$$R_{tot}^{(u)} \approx 0.012\, N_S \nu_S F_1 G_1 \delta_{eq}/f^2,$$

$$R_{Tot}^{(o)} \approx 0.23 \times 10^{-4} \sqrt{F_1}\sqrt{N_S}\,\delta_{eq}.$$

The various quantities in these equations are N_s, ν_s—the electron density and collision frequency behind a normal shock; F_1, G_1—geometry factors for the electron density and collision frequency; δ_{eq}—the equivalent plasma layer thickness; and f—the operational frequency. When a space vehicle reenters the atmosphere, the attenuation suddenly increases to large figures when f_p/f becomes larger than one. For the corresponding boundary value f_{po}, the following can be written: $f_{po} = f = 9000\sqrt{N_S F_1}$. The relations expressed in the above equations are then combined with the trajectory data for a specific flight. This permits the determination of the times for entering into and leaving "blackout" by finding the times when the curve for the considered antenna location reaches the value f_p, which is equal to the operational frequency. I.v.L.

N64-29550 Army Electronics Research and Development Activity, Fort Huachuca, Ariz.
A REVIEW OF THE CALCULATION OF RADAR REFRACTION ERRORS
Kenneth M. Barnett, Steven J. Bomba, Terry W. Heil, and Ernst K. Kirchner Jun. 1964 57 p refs
(USAERDAA-MET-7-64; AD-441874)

Using geometric optics and Snell's law, formulas are derived to calculate the error in radar position observations due to atmospheric refraction. Each approximation used in the mathematical derivation is analyzed. The resulting approximate mathematical formulas are shown to be accurate to one part in 10^5, assuming that geometrical optics are valid. The limitations on meteorological data required for an operational application of these formulas are reviewed briefly. This review is limited to errors caused by atmospheric refraction to ranges of 100 miles, and to altitudes of 15,000 ft. Meteorological data for southern Arizona show that this method should be used for observations with radar elevation angles of one-half degree or higher, to avoid ducting. Author

N64-29581 Aerospace Corp., El Segundo, Calif. Electronics Research Lab.
ELECTRONICS RESEARCH PROGRAM: INVESTIGATION OF MILLIMETER-WAVE MODULATION AND SIGNAL PROCESSING TECHNIQUES Semiannual Technical Report, 1 Jul.–31 Dec. 1963
L. A. Hoffman, H. J. Wintroub, and C. J. Carter 28 May 1964 72 p refs
(Contract AF 04(695)-269)
(SSD-TDR-64-52; TDR-269(4250-45)-2; AD-446429)

An investigation of millimeter-wave modulation and signal processing techniques was undertaken. The purpose of this investigation is to advance the technology and determine the

feasibility of millimeter-wave systems in the region between 10 mm (30 Gc) and 1 mm (300 Gc). Initial effort centers on two problem areas—low-noise receiver front ends and stable millimeter-wavelength reference sources. A parametric amplifier approach to low-noise receiver design is being studied, as is the use of a phase-locked klystron system as a stable reference source. Design and fabrication status of the klystron system is presented. Author

N64-29582 Aerospace Corp., El Segundo, Calif.
SYNTHETIC-APERTURE RADAR
Jean A. Develet, Jr. 14 Aug. 1964 119 p refs
(Contract AF 04(695)-269)
(SSD-TDR-64-125; TDR-269(9990)-8; AD-447089)

The theory of the focused synthetic-aperture mapping radar systems is discussed. The topics treated include theory of operation, image design, image simulation, system degradations, data format for remote transmission, doppler beam steering, and fundamental resolution limits. Author

N64-29604 Lincoln Lab., Mass. Inst. of Tech., Lexington
PROBABILITY DENSITY FOR THE RADAR CROSS SECTION OF ONE OR MORE RANDOMLY-ORIENTED DIPOLES Group Report
S. L. Borison 22 Jun. 1964 22 p refs
(Contract AF 19(628)-500; ARPA Order-498)
(ESD-TDR-64-341; AD-442679)

An examination was made of the electromagnetic scattering from low-density, randomly oriented chaff. Exact integral expressions for the radar-cross-section probability density for one or more dipoles, $p_N(\sigma)$, are derived. Using an approximate expression for the angular dependence of the cross section, the density for one dipole is found to be a simple analytic expression. For two dipoles, numerical integrations were performed. It is concluded that the Rayleigh density is a good approximation for $N > 1$ if σ is at least greater than $\sigma_{avg} = N(\sigma_0/5)$, where σ_0 is the peak cross section of a single dipole. Author

N64-29609 Lincoln Lab., Mass. Inst. of Tech., Lexington
PROBABILITY DISTRIBUTION OF ANTENNA GAIN FOR SATELLITE WITH SWITCHED ANTENNA SYSTEM Technical Report No. 347
R. N. Assaly 4 Feb. 1964 50 p ref
(Contract AF 19(628)-500)
(ESD-TDR-64-28; AD-602484) OTS: $3.00

For a communication system using satellites carrying antennas tied to a switching system, the probability distribution of angles between the pointing directions of the axis of the operating antenna and of a ground receiving station is found. This study is based on the condition that the antenna pointing most nearly in the direction of a sensing signal is switched on. In the determination of the characteristics of this system, geometries of pointing directions are found, which are optimum or near optimum, for the cases of 4, 6, 8, 12, 16, 24, 32, 48, and 60 antennas. Consideration is also given to determining an optimum antenna pattern to be used with any geometry. For any pattern, a conversion from probability distribution of angles to probability distribution of gains is straightforward. The results of this study are summarized in a chart. Author

N64-29618 Lincoln Lab., Mass. Inst. of Tech., Lexington
MILLSTONE HILL OBSERVATORY. LINCOLN MANUAL 51, VOLUME 1
Apr. 1964 293 p
(Contract AF 19(628)-500)
(ESD-TDR-64-53; AD-443421)

This manual was prepared to instruct personnel in the organization and operation of equipment located at Millstone Hill Observatory—the tracking radar system with associated timing and data-processing equipment, and the zenith-pointing antenna system with its ionospheric laboratory. The manual is divided into two volumes—one of text, the other of illustrations. The chapters included in the manual are Introduction, Clock (MOUSE), Master Timing Generator, Synthesizer and Exciter, Transmitters, RF Plumbing, Receiver, Sequential Doppler Processor, Doppler Analyzer Display, Tracker, Computer Interface (BORGIA), and Ionospheric Equipment. Author

N64-29619 Lincoln Lab., Mass. Inst. of Tech., Lexington
MILLSTONE HILL OBSERVATORY. LINCOLN MANUAL 51, VOLUME 2
Apr. 1964 263 p For Abstract see N64-29618 21-08
(Contract AF 19(628)-500)
(ESD-TDR-64-54; AD-443422)

N64-29620 Lincoln Lab., Mass. Inst. of Tech., Lexington
MILLSTONE L-BAND MONOPULSE RADAR ANTENNA SYSTEM PREVENTIVE AND CORRECTIVE MAINTENANCE PROCEDURES Lincoln Manual 53
Dec. 1963 53 p
(Contract AF 19(628)-500)
(ESD-TDR-63-585; AD-443480)

Information is presented for the maintenance of the Millstone L-band monopulse radar antenna system at a high level of performance. The manual contains three sections: (1) Functional Description; (2) Preventive Maintenance Procedures; and (3) Corrective Maintenance Procedures. A.W.

N64-29682 Aerospace Corp., El Segundo, Calif.
A STUDY OF NON-RANDOM RANGE, AZIMUTH, AND ELEVATION RESIDUALS INDUCED AT THE OBSERVATION SITE
T. P. Gabbard, Jr. Jun. 1964 41 p
(Contract AF 04(695)-269)
(TOR-269(4110-01)-46; AD-602971)

The station-induced nonrandom errors are of two types. The first are those associated with the equipment where the only nonrandom error appears as a bias term. (In the case of range, this bias may be due to a poor range "zero" calibration.) The second are associated with the origin and orientation of the reference frame. Range, azimuth, and elevation residuals are derived. In order to interpret these true residuals, plots of simulated residuals are generated over three passes—low elevation, intermediate elevation, and high elevation. I.I.

N64-29685 Keystone Controls Corp., Newark, N.J.
CRYSTAL UNIT CR-(XM-28)/U Quarterly Progress Report Jan.–Mar. 1964
James M. Ronan [1964] 27 p
(Contract DA-36-039-SC-81275)
(AD-602172)

The establishment of a facility to manufacture crystal units (operating at five different frequencies) and utilizing all-glass holders is discussed in general. The particular area of investigation was in testing the crystal frequencies against the National Bureau of Standards standard frequency. The systems used in carrying out these tests are discussed in detail. P.V.

N64-29701* Utah State U., Logan Antenna and Propagation Lab.
A LOG PERIODIC MONOPOLE ANTENNA Final Report
Clayton Clark, G. Paul Francis, and Ming-hui Chen 20 Jul. 1964 96 p refs
(Grant NsG-221-62)
(NASA-CR-58628) OTS: $8.60 ph

CONTENTS:

1. ANALYSIS OF A CAVITY-MOUNTED LOG-PERIODIC MONOPOLE ANTENNA G. P. Francis p 1–41 refs (See N64-29702 21-08)

2. THE RADIATION PATTERNS OF A LOG PERIODIC MONOPOLE ANTENNA Ming-hui Chen p 1–33 refs (See N64-29703 21-08)

N64-29702* Utah State U., Logan

ANALYSIS OF A CAVITY-MOUNTED LOG-PERIODIC MONOPOLE ANTENNA

G. Paul Francis *In its* A Log Periodic Monopole Antenna 20 Jul. 1964 p 1–41 refs (See N64-29701 21-08) OTS: $8.60 ph

The monopole as used in this study consists of a single "toothed" structure mounted above a reflecting sheet. The driving terminals are the tip of the monopole and the reflecting sheet. The monopole has been mounted in a number of ways including flush mounting over an air-filled cavity and over a dielectric-filled cavity. The performance of the structure has been calculated and measured for each mounting arrangement over a frequency range of 2 Gc to 4 Gc. Results are summarized. This report covers the investigation (primarily by digital computer techniques) of the H-plane radiation pattern of the antenna when mounted over a cavity. Information is also given on the E-plane patterns and the driving point impedance. Author

N64-29703* Utah State U., Logan

THE RADIATION PATTERNS OF A LOG PERIODIC MONOPOLE ANTENNA

Ming-Hui Chen *In its* A Log Periodic Monopole Antenna 20 Jul. 1964 p 1–33 refs (See N64-29701 21-08) OTS: $8.60 ph

Two general equations of radiation patterns are derived. One is a three-dimensional radiation pattern in air; the other is a two-dimensional radiation pattern (H-plane) when the source is immersed in a dielectric medium. The patterns were calculated on the IBM-1620 computer and compared with the measured patterns. Author

N64-29731 Lincoln Lab., Mass. Inst. of Tech., Lexington

AUTOMATIC DOPPLER CONTROL FOR THE WEST FORD ANTENNA POINTING SYSTEM

J. E. Gillis 25 Jun. 1964 23 p

(Contract AF 19(628)-500)

(GR-1964-35; ESD-TDR-64-342; AD-602080) OTS: $0.75

An automatic doppler control system has been added to the West Ford site. This system permits generation of local oscillator frequencies by use of a frequency synthesizer, which is in turn driven by the normal West Ford pointing system, local analog pointing systems, or the Haystack–West Ford intersite coupling system. Author

N64-29746 Lockheed Missiles and Space Co., Sunnyvale, Calif.

AN OPTICAL CORRELATION DETECTOR FOR THE AUDIO FREQUENCY RANGE. TECHNICAL REPORT: COMMUNICATIONS

J. K. Parks Aug. 1964 30 p refs

(Rept.-5-13-64-9)

A noncoherent optical correlation detector of the stored reference type is described. The correlator performs real-time correlation of multiple delayed signals with the stored reference without a priori knowledge of the signal delays. The correlator makes use of real-time integration, thereby making it unnecessary to record received signals prior to correlation. An experimental version of the correlator is described, its performance is analyzed, and the predicted performance is compared with the observed performance and found to agree to within 3 db. A signal-processing gain of 20 db is obtained with the experimental version of the correlator. Author

N64-29761 Bendix Corp., Ann Arbor, Mich. Bendix Systems Div.

ANTENNA WINDOW: A TECHNIQUE FOR PROPAGATION THROUGH A PLASMA SHEATH Interim Engineering Report No. 12, 15 Mar.–15 Jun. 1964

Robert G. De Losh [1964] 8 p

(Contract AF 33(616)-8420)

(BSR-985; AD-602816) OTS: $1.00

Several improvements of the antenna window system are described including the use of cryogenic pumping to evacuate the Dewar; inclusion of a spare transmitter in the payload, which may be electrically substituted for the main transmitter in the advent of a prelaunch transmitter failure; and, replacement of the solenoid switch driver with a pneumatic bellows. Author

N64-29791 Michigan U., Ann Arbor Cooley Electronics Lab.

THE RECTANGULAR CAVITY SLOT ANTENNA WITH HOMOGENEOUS ISOTROPIC LOADING

A. T. Adams Mar. 1964 202 p refs

(Contract AF 33(657)-10607)

(TR-147; Rept.-05549-7-T; AD-603657)

The rectangular cavity slot antenna, with dielectric or magnetic loading, and with a compound iris in the aperture plane, is analyzed utilizing variational techniques to derive accurate design guides for efficiency, bandwidth, and resonant frequency. The problem is broken up into several steps. The admittance of a loaded semi-infinite waveguide opening out into an infinite ground plane is analyzed using variational techniques; the normalized admittance is computed for a variety of values of μ_r, ϵ_r, b/a, and frequency. The effect of the compound iris is analyzed; a stationary expression is obtained for the admittance of a loaded semi-infinite waveguide opening out into an infinite ground plane, with a compound iris in the aperture plane. This expression is evaluated using two different approximations of aperture field. It is shown, and verified by experiment, that the errors incurred are not serious. The effect of the feed and the finite length of the cavity are taken into account by, respectively, perturbation techniques and network transformations. Author

N64-29803 Harvard Coll. Observatory, Cambridge, Mass.

MEASUREMENTS OF RADIO NOISE AT 0.700 MC AND 2.200 MC FROM A HIGH-ALTITUDE ROCKET PROBE

G. R. Huguenin, A. E. Lilley, W. H. Mc Donough, and M. D. Papagiannis Jul. 1964 25 p refs

(Contract AF 19(628)-3890)

(AFCRL-64-596; AD-604366)

Radio noise observations at frequencies of 0.700 mc and 2.200 mc were made at altitudes between 3,000 and 11,000 km from a Blue Scout Jr. high-altitude rocket probe on 30 July 1963. A steady background flux of $(7.5^{+6}_{-3}) \times 10^{-19}$ w m^{-2} (c/s)$^{-1}$ at 0.700 mc and $(1.8^{+1.0}_{-0.5}) \times 10^{-19}$ w m^{-2} (c/s)$^{-1}$ at 2.200 mc was observed. Assuming a galactic origin of the observed fluxes at both frequencies, the averaged sky brightnesses are b(0.700 mc) = $(6^{+5}_{-3}) \times 10^{-20}$ w m^{-2} (c/s)$^{-1}$ sr^{-1}, and b(2.200 mc) = $(1.4^{+1.0}_{-0.5}) \times 10^{-20}$ w m^{-2} (c/s)$^{-1}$ sr^{-1}. The observed brightness at 2.200 mc is in reasonable agreement with the results of other observers. The apparent brightness at 0.700 mc is, however, greater than was expected from previous observations. Author

N64-29817 Syracuse U., N.Y. Research Inst.
SIDELOBE REDUCTION AND GAIN CHARACTERISTICS OF PARTIALLY UNIFORM ANTENNA ARRAYS
Bradley J. Strait and David K. Cheng Griffiss AFB, N.Y., RADC, Aug. 1964 66 p refs
(Contract AF 30(602)-2646)
(RADC-TDR-64-243; AD-604727)

It has been found that sidelobe reduction can be effected by properly adjusting the excitation amplitudes in the outermost elements of a uniform array. This report presents a systematic method for determining these amplitudes exactly. The method can be applied to both broadside and endfire arrays, and can be used to eliminate radiation in any particular direction. By forcing a controlling factor to be a Chebyshev polynomial, a given amount of sidelobe suppression throughout the visible range can be guaranteed. Compared to Dolph–Chebyshev arrays designed for a certain range of sidelobe levels, partially uniform arrays offer higher directive gains and lower maximum-to-minimum amplitude ratios, as well as much simpler excitation requirements. Author

N64-29824 Rome Air Development Center, Griffiss AFB, N.Y.
LOG-PERIODIC ANTENNA GROUP AN/TSA-17 Test and Evaluation Report
Adolph J. Uryniak Jun. 1964 28 p refs
(RADC-TDR-64-178; AD-604334)

A 2.5-kw peak envelope power (PEP) nonrotatable restricted height, lightweight, transportable, quickly erectable antenna in the 2- to 30-mc region using the log periodic principle has been developed for TAC application. The antenna (AN/TSA-17) can be erected in less than two hours by 5 men. The disassembled antenna array is packaged in three carrying cases, and the dismantled supporting towers are nested in three bottom 10-ft sections. Total antenna weight is 850 pounds. Author

N64-29826 Johns Hopkins U., Baltimore, Md. Carlyle Barton Lab.
SEQUENTIAL DETECTION II
David Middleton Griffiss AFB, N.Y., RADC, Jul. 1964 58 p refs
(Contract AF 30(602)-2597)
(RADC-TDR-64-195; AD-604740)

Three problems involving sequential detection are considered in this study: (1) canonical forms for weak-signal, or threshold detection; (2) conditions for the singularity and nonsingularity of optimum detection procedures for normal noise in normal noise; and (3) useful experiments involving binary sequential detection, particularly where analytic results are not obtainable. Author

N64-29829 Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J.
A SIMPLIFIED VARIABLE POLARIZATION ANTENNA
John L. Kerr May 1964 32 p refs
(USAEL-TR-2423; AD-604254)

Development of a simplified variable-polarization antenna was based on a waveguide feed arrangement in which a polarizing element and the input field were independently rotatable about the axis of propagation. A squeeze section polarizer with a cross section approaching an ellipse seemed particularly useful in applications at millimeter wavelengths. Such a polarizer was fabricated by squeezing round copper tubing in a roller device in which the amount and length of squeeze could be precisely controlled. With this variable-polarization antenna, linear polarization in any plane about the axis of propagation and rotating linear polarization may be easily obtained. Right or left circular polarization, also right or left elliptical polarization of any axial ratio between linear and circular may be selected. Author

N64-29831 Aerospace Corp., El Segundo, Calif. Electronics Research Lab.
RADAR MAPPING OF DISTRIBUTED TARGETS
A. W. Rihaczek 1 Jul. 1964 28 p refs
(Contract AF 04(695)-269)
(SSD-TDR-64-105; TDR-269(4250-43)-3; AD-604752)

Conventional radar theory deals with point targets, and though a distributed target must necessarily be composed of a large number of point scatterers, there remain some doubts as to how applicable the existing theory is to continuous target distributions. The study starts with a brief justification of the target model used, and then invokes the sampling theorem to show under what conditions the continuous distribution can be replaced by an equivalent set of point targets, so that conventional theory can be employed to analyze the resolution problem. In this process it becomes apparent that the common definition of resolution, the half-power width of the receiver response, is not satisfactory for high-performance radar. Instead of a single quantity, four "indices of resolution" are needed for an adequate description of the resolution performance of a radar. Author

N64-29832 Washington State U., Pullman Div. of Industrial Research
POLAR HIGH FREQUENCY RADIO PROPAGATION STUDY Final Report, 1 Mar. 1963–29 Feb. 1964
Lloyd B. Craine, David H. Schrader, Harold Hadaller, and William A. Flatt 30 Jun. 1964 60 p refs
(Contract AF 19(628)-2488)
(RR-64-16-46; AFCRL-64-365; AD-604248)

An 18-mc radio propagation study was conducted using a pulse transmitter and rotating directional antenna at Thule, Greenland, and a fixed directional antenna and receiving system at Pullman, Washington. The 3,930-km cis-polar path is perpendicular to the auroral zone, and the zone is about 60% of the distance from Thule. The Thule–Pullman pulse reception data were examined to obtain hourly median signal strengths, pulse characteristics for various relative time delays, and pulse characteristics associated with transmitting antenna azimuth angle. Author

N64-29859 Navy Electronics Lab., San Diego, Calif. Radio Physics Div.
MAGNETIC COMPONENTS RADIATED BY A HORIZONTAL DIPOLE AT VLF Research Report, Jul. 1963–Jan. 1964
R. R. Harrington 4 May 1964 28 p refs
(NEL-1221; AD-602804)

An expression has been developed for the ratio of electromotive forces induced by sky and surface waves in a vertical loop along the perpendicular bisector of a horizontal VLF antenna near a surface of relatively high conductivity. If the ratio of emf's so induced is known, the equation can be used to calculate the ionospheric reflection coefficient for a wave horizontally polarized before and after reflection. The effects of nonhomogeneous ground conductivity are also examined. Author

N64-29880 Lockheed Missiles and Space Co., Sunnyvale, Calif.
PERFORMANCE OF THE DELAY-LOCK TRACKING DISCRIMINATOR WITH BINARY SIGNALS
R. A. Dye Apr. 1964 48 p refs
(Rept.-6-74-64-18; AD-600599)

This report describes the performance of the binary delay-lock tracking discriminator as evaluated from laboratory-simulated environments. A binary delay-lock discriminator was constructed, and performance was observed when operated in noise with doppler-shifted return signals and with a multipath channel. Experimental verification of much of the earlier theoretical work was accomplished and, in some cases, performance in excess of that previously predicted was observed. Author

N64-29909 Air Force Cambridge Research Labs., Bedford, Mass. Office of Aerospace Research
LASER-SATELLITE REFLECTION PARAMETERS
Robert L. Iliff Jun. 1964 19 p refs *Its* Environmental Res. Papers No. 23
(AFCRL-64-475; AD-605270)

Satellites of various configurations are examined as possible laser reflectors. Attention is given to the nature of the reflected signal, atmospheric attenuation, and problems involved in aiming the laser. Nomograms are presented for the determination of the geometric attenuation of the signal as a function of laser divergence, range, target size, receiver aperture, and, where applicable, divergence caused by degraded corner reflector. Author

N64-29927 Sylvania Electrics Products, Inc., Mountain View, Calif. Electronic Defense Labs.
HIGH FREQUENCY ANTENNA STUDY: LOG PERIODIC VERSUS RHOMBIC Technical Memorandum
Normand Barbano and Ernest Robles 14 Feb. 1964 92 p refs
(Contract DA-36-039-SC-89258)
(EDL-M548; AD-445349)

In order to establish some basis that shows under what circumstances a log periodic antenna can be used to best advantage for HF communications networks, a comparison is made in this report between log periodic and the rhombic antenna. Prior to making the comparison, the characteristics of each of the antennas are discussed to point out some of their advantages and limitations. The comparison itself between the antennas is made on the basis of how they satisfy the antenna requirements of specific communications networks. Author

N64-29934 Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J.
ULTRA-SENSITIVE VOICE TRANSMISSION INDICATING CIRCUIT
William F. Kiss, Russell A. Gilson, and Dennis Bowman Jun. 1964 14 p
(AEL-TR-2469; AD-604271)

This report describes the design and operation of an indicating circuit developed for use in a fire support and coordination center. The main function of the circuit is to provide a means of indicating when a particular voice channel of a receiver is in operation. Author

N64-30001 New Hampshire U., Durham Antenna Systems Lab.
DIGITAL COMPUTER DESIGN OF THE DIPOLE PARAMETRIC AMPLIFIER ANTENNA Scientific Report No. 2
Albert D. Frost 1 May 1964 53 p refs
(Contract AF 19(628)-307)
(AFCRL-64-447; AD-604171)

A procedure for the design of the coaxial dipole form of parametric amplifier antenna is outlined. This includes a presentation of the factors involved and the criteria used in the calculation of optimum dipole length, the design of the interior coaxial cavity, the selection of an output loop, and the idler frequency location. Computer programs (IBM 1620) are provided for the procedures described, together with a table of dual coaxial line impedance parameters. Author

N64-30037 Lincoln Lab., Mass. Inst. of Tech., Lexington
CROSS-SECTION MEASUREMENTS OF THE ECHO II SATELLITE BY THE MILLSTONE L-BAND RADAR Group Report 1964-16
R. F. Julian and D. P. Hynek 7 Apr. 1964 12 p
(Contract AF 19(628)-500)
(ESD-TDR-64-43; AD-602751) OTS: $1.00

All cross-section measurements beginning with Rev. 4, the first observable at Millstone, display a fading pattern indicating that the balloon had not attained full sphericity, or at least contained significant surface irregularities. No essential change in the fading pattern was noted throughout the period that measurements were taken, except for perhaps more frequent fading during the later passes. Starting with Rev. 5, the first complete horizon-to-horizon measurement made, a periodicity of approximately 104 sec, was observed. This periodicity was also apparent during the later passes. The estimated average radar cross section during these observations was about one-half the theoretical 1,330 m^2. Author

N64-30108 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
PHYSICAL DESIGNS AND EXAMPLES OF APPLICATION OF FREQUENCY-INDEPENDENT ANTENNAS
Hans-Joachim Fischer 10 Jul. 1964 17 p refs Transl. into ENGLISH from Radio und Fernsehen (Germany), v. 12, no. 18, 1963 p 557–560
(FTD-TT-64-554/1+2+3+4; AD-603456)

The forms taken by broadband antennas are described briefly, and the logarithmic-periodic dipole antenna in its various modifications is discussed at length. Practical design of a log-periodic antenna and the technical specifications for such an antenna are discussed. D.E.W.

N64-30120 RAND Corp., Santa Monica, Calif.
COHERENT DETECTION OF RADAR RETURNS OF UNKNOWN DOPPLER SHIFT
Ivan Selin Aug. 1964 36 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4227-PR; AD-604857)

This memorandum presents a solution to the problem of detection by phase-coherent techniques of radar returns of unknown doppler shift. In addition to the solution of the problem, the memorandum contains a discussion of earlier approaches and the circumstances in which they are useful. A discussion of the filter design, as well as the mathematical derivation of the desired filter operation, is included. The filter is also suitable for sequential detection. Author

N64-30179 Lincoln Lab., Mass. Inst. of Tech., Lexington
RADAR Quarterly Progress Report, Division 4, 1 Mar.–31 May 1964
J. Freedman and H. G. Weiss 15 Jun. 1964 20 p ref
(Contract AF 19(628)-500; ARPA Order 166; ARPA Order 498; Proj. Defender)
(ESD-TDR-64-335; AD-442680)

The report details progress in range measurements with 8-mm lunar radar and 8-mm radiometry; the Haystack Hill microwave components including the 7750 mc/sec transmitter, feed horn and circular polarizer, low-noise receivers, noise rejection filters, and waveguide flanges and gaskets; a study of surface resistivity of such components; solid-state amplifiers; and short-pulse probing of transmission lines. A.W.

09 ELECTRONICS

Includes circuits and circuit theory; electronic components (e.g., tunnel diodes, transistors, and tubes); and feedback and control theory. *For related information see*: 06 Auxiliary Systems; 08 Communications; 15 Instrumentation and Photography; 22 Navigation and Guidance; and 25 Physics, Solid-State.

N64-29029* Wisconsin U., Madison Mathematics Research Center
ELECTRIC WAVE PROPAGATION ON NON-UNIFORM COUPLED TRANSMISSION LINES
Calvin H. Wilcox Jan. 1963 50 p refs
(Contract DA-11-022-ORD-2059)
(MRC-TSR-376; AD-401187)

The propagation of electric currents and voltages along a pair of wires over a ground plane is studied. The system is assumed to be nonuniform; i.e., the self and mutual inductances vary along the wires. The existence and uniqueness of an electric wave having prescribed initial values are shown to follow from recent results on symmetric hyperbolic systems of partial differential equations. A construction for this solution is given in the case of a coupler (i.e., a pair of wires that are nonuniform and coupled over a portion of their length only). This coupler problem is reduced to a two-point boundary-value problem, and the latter is reduced to a pair of initial value problems, one of which involves a matrix Riccati equation. Author

N64-29072 Israel Program For Scientific Translations, Ltd., Jerusalem
MODERN HIGH-FREQUENCY TRANSISTORS [SOVREMENNYE VYSOKOCHASTOTNYE TRANZISTORY]
Yu. S. Ryabinkin *In its* Advan. in Phys. Sci., v. 65, nos. 1–4, May–Aug. 1958 1964 p 510–541 refs (See N64-29052 21-23) OTS: $5.75

A theoretical description of junction transistors is presented. The following ways of manufacturing transistors are discussed: (1) double diffusion method; and (2) production of p-n-p and n-p-n structures based on the difference between the segregation coefficients of donor and acceptor impurities—rate-growing, meltback method, directed unilateral recrystallization (zone melting), "freezing-in" of impurities, and internal diffusion (diffusion in the solid state). The following are also discussed: surface-barrier triodes, semiconductor tetrodes, the qualitative peculiarities of narrow-base triodes, and the possibilities for further improvement of transistor frequency response. P.V.E.

N64-29100 Microwave Associates, Inc., Burlington, Mass.
SOLID-STATE GENERATOR Quarterly Progress Report, 1 Mar.–30 Jun. 1964
E. Scherer [1964] 9 p ref
(Contract NObsr-89356)
(QPR-4; AD-602145)

Work summarized in this report was concerned with the following: (1) improving frequency stability of the 500 mc/s oscillator; (2) increasing bandwidth and power capacity of the multiplier doubling from 500 to 1,000 mc/s; and (3) studies of a new type of multiplier tripling from 1,000 to 3,000 mc/s. P.V.E.

N64-29213* Space Craft, Inc., Huntsville, Ala.
DEVELOPMENT OF AN ACTIVE FILTER SYNTHESIS PROCEDURE Summary Report, 20 May 1963–20 May 1964
Russell E. Lueg and James T. Dixon, (Alabama U.) 23 Jun. 1964 107 p refs
(Contract NAS8-5347)
(NASA-CR-58694) OTS: $9.10 ph

This research study constitutes a joint effort by Space Craft, Inc., and the University of Alabama Bureau of Engineering Research to develop a synthesis procedure for synthesizing a four-pole, four-zero transfer function used for stabilization of an accelerometer control loop. Two methods of synthesizing the transfer function were investigated. The first consisted of placing networks in the control loop of an operational amplifier. Because of the complexity of the networks when used with an operational amplifier, attention was then focused toward the use of a buffer amplifier to partition the transfer function. This partitioning provided simpler transfer functions that were more easily synthesized. The part of the transfer function with real poles and zeros was synthesized by repeated zero shifting and pole removal, resulting in a ladder network. The part of the transfer function with complex zeros is synthesized by the Dasher Method. A simplified form of the synthesis procedure is presented. Author

N64-29279 Sylvania Electric Products, Inc., Mountain View, Calif. Microwave Device Div.
INVESTIGATION OF NEW CONCEPTS FOR OPTICAL MIXING Final Report
B. J. Mc Murtry, M. K. Oshman, A. E. Siegman, and W. B. Tiffany 10 Oct. 1963 105 p refs
(Contract AF 19(628)-2472)
(AFCRL-63-508; AD-604489)

The objective of this program is to conduct a theoretical investigation of new concepts for mixing optical signals and, from analysis, to determine which methods warrant experimental development. The technical approach to this problem can be briefly summarized as follows: (1) list all known photomixing devices that could possibly be used at frequencies above 50 Gc; (2) examine each device theoretically to determine its inherent frequency-response limitations; and (3) recommend which device (or devices) should receive further experimental investigation. Author

N64-29313 Microwave Associates, Inc., Burlington, Mass.
C- AND Ku-BAND SEMICONDUCTOR TR DEVICES Third Quarterly Progress Report, 1 Jan.–31 Mar. 1964
R. H. Brunton [1964] 28 p refs
(Contract DA-36-039-AMC-03187(E))
(Rept.-3; AD-445031)

All work performed on the Ku-band investigation during this period was concerned with full height Ku-band waveguide

diode mounts. The PIN and varactor diodes have been measured using forward d.c. bias to simulate high-power isolation and zero bias to provide the low loss condition. Additional work has been carried out utilizing high burnout crystal detectors to provide the forward bias for the PIN and the varactor during high-power tests. High-power tests resulted in the successful operation of a two-stage switched limiter. Operational data are given for peak powers up to 1,000 w. Author

N64-29319 Stanford Research Inst., Menlo Park, Calif.
TUNNEL CATHODES FOR MICROWAVE TUBES Interim Report, 1 Mar.–31 May 1963
D. V. Geppert and B. V. Dore Jun. 1963 35 p refs
(Contract AF 33(657)-8721)
(IR-4; AD-409278)

Two vacuum deposition systems are now in operation. One system is designed specifically for CdS work, and the other system for other insulating barrier materials. Both systems have quartz crystal film-thickness monitors in operational use. In both systems, the complete three-layer cathode structure can be fabricated completely in vacuum. The structures Au-SiO-Au, Mo-SiO-Mo, and Mo-CdS-Mo have been studied. The Mo-SiO-Mo structure is the most promising cathode so far tested. It shows potential for high efficiency and long life. The calculations of the relaxation frequency of hot electrons and holes in metals and semiconductors have now been completed. The calculations for hot holes in metals are presented. In addition, numerical results have been calculated and presented in such a way that a comparison can be made with Quinn's theory. Author

N64-29322 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
COLLECTION OF REPORTS ON AUTOMATION (Selected Articles)
17 Jul. 1963 42 p refs Transl. into ENGLISH from the book Souhrn Praci o Automatisaci Prague, Nakladatelstvi Cesk. Akad. Ved., 1961 p 19–34, 125–147
(FTD-TT-63-387/1+2; AD-413985)

CONTENTS:

1. METHOD TO DETERMINE OPTIMUM CORRECTION FACTORS FOR LINEAR SINGLE-LOOP CONTROL CIRCUIT K. Reinisch p 1–16 refs (See N64-29323 21-09)
2. NUMERICAL SOLUTION OF A NONSTATIONARY RANDOM PROCESS OF PASSING WITH CONTROL CIRCUITS WITH NONLINEAR PARAMETERS J. Benes p 17–39 (See N64-29324 21-09)

N64-29323 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
METHOD TO DETERMINE OPTIMUM CORRECTION FACTORS FOR LINEAR SINGLE-LOOP CONTROL CIRCUIT
Karl Reinisch *In its* Collection of Rept. on Automation 17 Jul. 1963 p 1–16 refs (See N64-29322 21-09)

Transfer functions are calculated for single-loop, linearly constant, control circuits without dead time, which at a given control line and selected control are obtained through the chain relay of passive RLC or RC tripoles. By employing these functions it is possible, by two simple algebraic operations, to determine the transition function of the optimum correction network. Author

N64-29324 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
NUMERICAL SOLUTION OF A NONSTATIONARY RANDOM PROCESS OF PASSING WITH CONTROL CIRCUITS WITH NONLINEAR PARAMETERS
Jiri Benes *In its* Collection of Rept. on Automation 17 Jul. 1963 p 17–39 (See N64-29322 21-09)

A method is described for high-speed digital computation of the variance and average value at different points of control systems with typical nonlinearities and with slowly varying parameters, when nonstationary random processes with slowly varying characteristics are acted upon. The method is based on the periodical sampling of the realization of the random process and in the expansion of the samples in the series of Laguerre's functions using a new analog computer—the orthogonal analyzer using modulators with Laguerre's functions. The obtained Laguerre coefficients are used to approximate the periodograms of the samples. Author

N64-29358* Stanford Research Inst., Menlo Park, Calif.
RESEARCH ON THIN MAGNETIC FILM LOGIC DEVICES Final Engineering Report
M. W. Green Oct. 1961 49 p refs Prepared for JPL
(Contract NASw-6)
(NASA-CR-58559) OTS: $4.60 ph

An attempt was made to demonstrate the feasibility of an all-magnetic-logic system consisting of thin ferromagnetic films interconnected by passive thin-film coupling structures. A theoretical analysis of the dynamic behavior of two coupled magnetic-film elements is presented that tends to support the feasibility of the system, but only if extremely good coherent rotation of magnetization can be obtained, and if driving conditions can be very carefully controlled. Equipment was designed and constructed for the purpose of fabricating multilayer evaporated structures of the desired type. A novel feature of this apparatus is a means for measuring film thicknesses that employs several photocells located inside the vacuum chamber. Author

N64-29379 Illinois U., Urbana Coordinated Science Lab.
ROLE OF THE GENERALIZED LIPSCHITZ CONDITION IN FINITE-TIME STABILITY AND IN THE DERIVATION OF THE MAXIMUM PRINCIPLE
S. D. Agashé Jun. 1964 28 p refs
(Contract DA-28-043-AMC-00073(E))
(R-215; AD-602143)

The main purpose of this report is to show how important the generalized Lipschitz condition is in proving certain properties of varied solutions of differential equations. These are particularly useful in consideration of finite-time stability and in deriving the Pontryagin maximum principle. It is shown that if a system satisfies a generalized Lipschitz condition in the state variables, it is finite-time stable with respect to the initial state. If it satisfies a generalized Lipschitz condition in the control, it is finite-time stable with respect to the control. Author

N64-29395 Collins Radio Co., Newport Beach, Calif.
FILTER CRYSTAL DEVELOPMENT PROGRAM (70 TO 150 MC) Third Quarterly Progress Report, 15 Jan.–15 Apr. 1964
R. A. Auriemma and W. D. Peterson 26 Jun. 1964 15 p refs
(Contract DA-36-039-AMC-03207(E))
(Rept.-523-1000615-00152M; AD-441978)

The configuration to be used for vacuum deposition of electrodes was finalized. The setup to be used for the balance

of the work on the contract was constructed and is illustrated. A radio receiver was connected to the lapping machine to monitor frequency while lapping blanks. Lapping of blanks was started. A setup was assembled for measuring the motional parameters of finished crystals, and some initial measurements were made. Author

N64-29397 McCoy Electronics Co., Mount Holly Springs, Pa.
CRYSTAL UNITS WITH IMPROVED TEMPERATURE CHARACTERISTICS Final Report, 1 Jul. 1962–31 Mar. 1964
D. E. Newell (Bendix Corp.), H. H. Hinnah, G. K. Bistline, and J. K. Reighter [1964] 76 p Prepared Jointly with Bendix Corp.
(Contract DA-36-039-SC-90820)
(SCL-6609; AD-445797)

This report describes the work performed and results obtained in attempting to compensate an AT oriented resonator. At thirty megacycles, on the third mode, three compensation techniques were investigated. The electronic compensation technique proved to be the most satisfactory method of compensating resonator temperature coefficient. Design procedures for utilizing the technique are outlined in detail. Author

N64-29403* Alabama U. Research Inst., Huntsville
GROOVE GUIDE MEASUREMENTS
F. J. Tischer and F. W. Someroski Aug. 1964 19 p refs
(Grant NsG-381)
(NASA-CR-58721; UARI-RR-17) OTS: $1.60 ph

Results of an experimental study of the groove guide are presented. The guide consists of two parallel conducting strips, each with a centrally located longitudinal groove facing each other. The field distribution, guide wavelength, and the attenuation were measured in specially designed test setups. The test setups and measurement circuits are described, and the measurement results are discussed. Author

N64-29407* Radio Corp. of America, Princeton, N.J. RCA Labs.
HIGH-EFFICIENCY NARROW-BAND LASER PUMP Final Report, Jan. 24, 1963–Feb. 28, 1964
S. A. Ochs and J. I. Pankove Huntsville, Ala., NASA, Feb. 1964 38 p refs
(Contract NAS8-5219)
(NASA-CR-58645) OTS: $3.60 ph

The pumping of a $CaF_2:Dy^{2+}$ laser by means of injection luminescence from $GaAs_{0.73}P_{0.27}$ pn junctions was studied. Diodes were made from such an alloy grown epitaxially on (100) GaAs. External conversion efficiencies of about one photon leaving the diode per 100 electrons traversing the junction were obtained. One hundred diodes were connected in series, in ten linear arrays, and were arranged around the laser rod. This assembly was immersed in liquid helium cooled below the lambda point. Single current pulses caused lasing when the total light output of the diodes was about 0.1 watt. An appreciable delay was found between the beginning of the current pulse and the onset of lasing. Heating effects limited the lasing action to about 0.2 second. Author

N64-29409 Magnavox Co., Fort Wayne, Ind. Government and Industrial Div.
QUARTZ CRYSTAL OSCILLATOR CIRCUITS STUDY Final Report, 1 Sep. 1962–10 Apr. 1964
D. Firth 10 Jun. 1964 16 p
(Contract DA-36-039-AMC-00043(E))
(TP64-1096; AD-601857)

Antiresonance and series resonance-type oscillators were investigated. The behavior of an antiresonant oscillator circuit was studied, using a Pierce-type triode oscillator circuit; to facilitate function separation and to validate analysis, the circuit was modified. Further modifications were made and studied in frequency ranges from audio to HF bands. Transistor amplifier and oscillator circuits were analyzed. Series resonance transistor oscillators in the 0.8- to 50-mc frequency range were examined by analysis of the common-base equivalent circuit as a tuned amplifier. The characteristics of series crystal units were considered in relation to the common-base amplifier characteristics, and a design procedure for the frequency range of 0.8 to 30 mc was developed. A design handbook was prepared for quartz-crystal oscillator design in the 1-kc to 200-mc frequency range for use by designers of quartz-crystal oscillators. Numerous references are made to this handbook. D.E.W.

N64-29419 Clevite Corp., Palo Alto, Calif. Shockley Research Lab.
NEW CONCEPTS FOR SOLID STATE MICROWAVE GENERATORS Fifth Quarterly Report, 1 Jan.–31 Mar. 1964
R. M. Scarlett [1964] 30 p refs
(Contract DA-36-039-AMC-00001(E))
(Rept.-5; AD-602093) OTS: $0.75

Errors arising in measurements of negative resistance and current gain of transit-time devices are discussed. A new circular geometry for these devices is introduced. Although improved results were obtained, corrected measurements show that the negative resistance is just large enough to cancel the package and lead resistance. The power loss in PIN diodes operating as harmonic generators is considered. The loss can be expressed in terms of the operating frequency and a transit frequency $f_t = v_h/4$ w, where w is the width of the I region, and v_h is the limiting carrier velocity. Author

N64-29439 Boeing Co., Renton, Wash. Transport Div.
THE DOMINANT CUTOFF WAVELENGTH OF A T-SEPTATE LUNARLINE Scientific Report 3
Ann Y. Hu and Dwight E. Isbell Jan. 1962 43 p refs
(Contract AF 19(604)-6189)
(AFCRL-62-80; AD-273615)

A method is presented for calculating the lowest cutoff wavelength of a new microwave transmission line, the T-septate lunar line. The T-septate lunar line is a modified lunar line formed by two eccentric circular metal tubes; part of the inner metal tube is cut out, and a metal bar is passed through the cutout section to connect the opposing inner surfaces of the two tubes. The cross section of the T-septate lunar line is approximated by introducing a series of steps in the outer guide wall and dividing the cross section into m fan-shaped regions. Thus, the problem is reduced to one of a multiple-step waveguide, and can be solved by introducing an angular parameter, α_i, for the individual regions and a coefficient ratio parameter, η, for the first composite region intersected by the inner metal tube. The radial boundary conditions require a combination of Bessel functions of noninteger order for each region. Author

N64-29454 Joint Publications Research Service, Washington, D.C.

RADIO ENGINEERING, NO. 1, 1964

17 May 1964 218 p refs Transl. into ENGLISH of Izv. Vysshikh Uchebn. Zavedenii: Radiotekhn. (Kiev), v. 7, no. 1, Jan.–Feb. 1964 p 1–128

(JPRS-25138: OTS-64-31514) OTS: $3.50

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N64-29455 Joint Publications Research Service, Washington, D.C.

ELECTRON-BEAM CONVERTERS FOR FUNCTIONS OF TWO VARIABLES

A. I. Petrenko *In its* Radio Eng., No. 1, 1964 17 May 1964 p 1–15 refs (See N64-29454 21-09) OTS: $3.50

Experience is reported in the construction of electron-beam functional converters for two independent variables, as employed in computation technology, simulation, and physical experimentation techniques. The converter is based on the resolution of a function of two variables into n functions of a single variable, for devices with a master mask of variable optical thickness, and for devices with linear interpolation of the values of the functions. Author

N64-29456 Joint Publications Research Service, Washington, D.C.

TRANSISTORIZED CURRENT STABILIZERS

V. I. Lebedev *In its* Radio Eng., No. 1, 1964 17 May 1964 p 16–29 refs (See N64-29454 21-09) OTS: $3.50

Three current stabilization circuits are considered. Expressions are derived for the stabilization coefficient and for the internal resistance. The problem of temperature instability of the load current is considered. The circuits under consideration can be used as a basis for a current stabilizer with an adjustable value of the stable current. Author

N64-29457 Joint Publications Research Service, Washington, D.C.

JUSTIFICATION FOR SUBDIVIDING COMPLICATED RADIO APPARATUS INTO BLOCKS WITH CONTROLLABLE OPERATING ABILITY

L. L. Barvinskiy *In its* Radio Eng., No. 1, 1964 17 May 1964 p 30–38 refs (See N64-29454 21-09) OTS: $3.50

The probability of normal functioning of complex radio apparatus with a system of automatic control over the operating ability, intended for the acceleration of the recovery, is of maximum significance at a certain optimal number of controlled blocks. A method for calculating the optimal number of controlled repaired blocks is given and justified. Author

N64-29458 Joint Publications Research Service, Washington, D.C.
MEMORY UNIT WITH TIME COMPRESSION OF THE SIGNAL
Yu. S. Trikoz *In its* Radio Eng., No. 1, 1964 17 May 1964 p 39–49 refs (See N64-29454 21-09) OTS: $3.50

A block diagram is presented of a unit with time compression of the signal and a recirculator employing an ultrasonic delay line. The influence of the limited bandwidth in the closed feedback loop on the shaping of the output signal is investigated. Author

N64-29459 Joint Publications Research Service, Washington, D.C.
TENSOR GREEN'S FUNCTION OF RECTANGULAR WAVEGUIDES AND CAVITIES
G. T. Markov and B. A. Panchenko *In its* Radio Eng., No. 1, 1964 17 May 1964 p 50–61 refs (See N64-29454 21-09) OTS: $3.50

Tensor Green's functions, which make it possible to write down the solutions of Maxwell's equations in compact form, are considered. Explicit expressions are given for the tensor Green's functions of rectangular waveguides and cavities. An example of the use of the Green's functions in setting up an integral equation with respect to the field in the aperture of a cavity excited and half-space bounded by an ideally conducting plane is given. Author

N64-29460 Joint Publications Research Service, Washington, D.C.
TRANSIENTS IN DISTRIBUTED SYSTEMS DURING THE TRANSMISSION AND SHAPING OF NANOSECOND PULSES
G. V. Glebovich *In its* Radio Eng., No. 1, 1964 17 May 1964 p 62–76 refs (See N64-29454 21-09) OTS: $3.50

The transient characteristics of coaxial and strip lines and their approximate expressions are given. The influence of losses in the conductors and in the dielectric of the line on the shape of the nanosecond pulses during transmission and formation is considered. The results of experimental investigations of transmission lines are presented. Author

N64-29461 Joint Publications Research Service, Washington, D.C.
OPERATION OF TRAVELING WAVE TUBES IN THE SECOND PASS BAND OF A DIAPHRAGMED WAVEGUIDE
Ya. K. Trokhimenko and V. L. Isakov *In its* Radio Eng., No. 1, 1964 17 May 1964 p 77–89 refs (See N64-29454 21-09) OTS: $3.50

On the basis of theoretical considerations and experimental research, an estimate is made of the possibility of operation of a traveling wave tube on the fundamental spatial harmonic of the slow-wave system of a type of resonator chain with positive inductive coupling. Author

N64-29462 Joint Publications Research Service, Washington, D.C.
BEHAVIOR OF TRAVELING WAVE TUBE NEAR THE PASS BAND BOUNDARY
G. N. Rapoport and V. Ye. Chayka *In its* Radio Eng., No. 1, 1964 17 May 1964 p 90–97 refs (See N64-29454 21-09) OTS: $3.50

The characteristic equation of a traveling wave tube for the case of an interaction between the beam and two spatial harmonics is derived on the basis of the theory of proper modes. A transition to the theory of three waves is indicated. Equations are obtained for the boundary conditions and the roots of the characteristic equation, and the initial losses are calculated for several particular cases. Author

N64-29463 Joint Publications Research Service, Washington, D.C.
PARAMETRIC AMPLIFIER WITH LOW FREQUENCY PUMPING USING SEMICONDUCTOR DIODES
B. M. D'yachenko and A. N. Gladyshev *In its* Radio Eng., No. 1, 1964 17 May 1964 p 98–109 ref (See N64-29454 21-09) OTS: $3.50

A parametric amplifier is considered with oppositely connected diodes, making it possible to obtain amplification by using a pumping generator with a frequency lower than the frequency of the amplified signal. Author

N64-29464 Joint Publications Research Service, Washington, D.C.
NONSTATIONARY PROCESS IN WAVEGUIDE RESONATORS WITH MOVING WALL
O. A. Stetsenko *In its* Radio Eng., No. 1, 1964 17 May 1964 p 110–123 refs (See N64-29454 21-09) OTS: $3.50

The nonstationary process is considered for a uniform contraction of an electromagnetic field in rectangular and round waveguides. Expressions are obtained for the field components in the case of nonrelativistic motion of the wall ($v\sqrt{\epsilon\,\mu} << 1$). The law governing the variation of the amplitude and frequency is determined. The energy relations in the system are investigated. Author

N64-29465 Joint Publications Research Service, Washington, D.C.
CONCERNING CERTAIN ERRORS OF SPECTRUM ANALYZERS WITH PRELIMINARY MAGNETIC RECORDING
N. F. Vollerner, V. G. Kriksunov, and R. M. Tereshchuk *In its* Radio Eng., No. 1, 1964 17 May 1964 p 124–130 refs (See N64-29454 21-09) OTS: $3.50

In spectral analysis apparatus, the investigated signals are first recorded on magnetic tape and are subsequently reproduced during analysis. A number of advantages of this procedure are listed, along with the disadvantage of introducing errors. Errors introduced into the recording by the spectrum analyzer in this preliminary stage, particularly those due to flutter in the speed of the recording medium, are considered in detail. D.E.W.

N64-29466 Joint Publications Research Service, Washington, D.C.
INCIDENCE OF PLANE WAVES ON THE INTERFACE BETWEEN VACUUM AND AN INHOMOGENEOUS ABSORBING MEDIUM
N. N. Fedorov *In its* Radio Eng., No. 1, 1964 17 May 1964 p 131–138 refs (See N64-29454 21-09) OTS: $3.50

The incidence of plane waves at an arbitrary angle on a plane interface between vacuum and an inhomogeneous absorbing medium, the parameters of which can vary in the directions of the coordinates, is considered. The field components produced in the second medium and on the separation boundary are considered, making it possible to obtain the diffraction field. Author

N64-29467 Joint Publications Research Service, Washington, D.C.
PROBABILITY DENSITY AT THE OUTPUT OF A MULTIPLIER IN CORRELATION RECEPTION

P. A. Gerastovskiy *In its* Radio Eng., No. 1, 1964 17 May 1964 p 139–148 refs (See N64-29454 21-09) OTS: $3.50

The probability densities are obtained for the product and scalar product of two normal random processes, each of which is the sum of mutually independent correlated signal and noise. An example is presented of the use of the results obtained for the determination of the error probability in relative phase radio telegraphy. Author

N64-29468 Joint Publications Research Service, Washington, D.C.

SENSITIVITY OF CIRCUIT FOR THE DIRECT DETECTION OF AMPLITUDE FLUCTUATIONS OF MICROWAVE GENERATORS

N. S. Skabovskiy *In its* Radio Eng., No. 1, 1964 17 May 1964 p 149–151 refs (See N64-29454 21-09) OTS: $3.50

The sensitivity of a circuit for the direct detection of microwave oscillator amplitude fluctuations is determined by the minimum level of the investigated fluctuations, distinguishable against the background of the intrinsic noise of the circuit. The sensitivity is characterized by the ratio $\gamma = P_s/P_{nf}$, where P_s is the high-frequency power at the detector and P_{nf} is the spectral density of the power of the minimally observed fluctuations. When using crystal diodes, their flicker noise determines the noise of the measuring circuit at the low frequencies. Author

N64-29469 Joint Publications Research Service, Washington, D.C.

VARIABLE WAVEGUIDE ATTENUATOR FOR HIGH POWER LEVEL

B. Z. Kanter *In its* Radio Eng., No. 1, 1964 17 May 1964 p 152–154 (See N64-29454 21-09) OTS: $3.50

The attenuator is a glass cylinder, which goes over gradually on its end into cones. The cylinder is placed inside a rectangular waveguide, parallel to its axis, and is supported in the waveguide on two glass tubes, which simultaneously serve to feed the cooling liquid. The tubes enter the waveguide through its narrow wall, are parallel to the broad wall of the waveguide, and enter the case of the attenuator near its center. Such an arrangement of the tubes for the supply of the cooling liquid reduces to a minimum the reflection from the tubes, since the electric field is concentrated essentially in the region of the case of the attenuator. Inside the case, the tubes terminate near the vertices of the cones. Because of this, the cooled liquid flows uniformly over all parts of the attenuator and any stagnation or boiling of the liquid is eliminated. The attenuation is regulated by moving the case of the attenuator from the narrow wall toward the center of the waveguide. Author

N64-29470 Joint Publications Research Service, Washington, D.C.

THEORY OF FREQUENCY SPECTRA AND DEMODULATION OF PULSES WITH PUSH-PULL DURATION MODULATION OF THE FIRST KIND

V. V. Malanov *In its* Radio Eng., No. 1, 1964 17 May 1964 p 155–161 refs (See N64-29454 21-09) OTS: $3.50

Push–pull pulse duration modulation of the first and second kind are used in pulsed amplification of audiofrequency oscillations, the qualitative indices of which can be established on the basis of an analysis of the frequency spectra and demodulation of the pulses with this modulation. Such an analysis, for modulation of the second kind, was carried out earlier. This paper considers the theory of frequency spectra and demodulation of pulses in push-pull duration modulation of the first kind. It is seen from calculations that in the modulation of the first kind the amplitude of the useful component of the pulse spectrum is proportional to the amplitude of the modulating signal. This means that in the modulation of the first kind, unlike modulation of the second kind, there is no frequency distortion of the signal due to the modulation principle. Author

N64-29471 Joint Publications Research Service, Washington, D.C.

AUTOMATIC PHASE CONTROL SYSTEM WITH DIVIDING CAPACITOR IN THE FEEDBACK LOOP

F. A. Pevzner *In its* Radio Eng., No. 1, 1964 17 May 1964 p 162–167 refs (See N64-29454 21-09) OTS: $3.50

The system under consideration is a static automatic phase control system, differing qualitatively from phase control systems that have no high-pass filters. The dividing capacitor introduced in the feedback loop gives incomplete partial differentiation of the error signal. It therefore becomes possible to call this system a phase-differential automatic control system. The residual frequency difference obtained in the circuit can be reduced to the desired value by choosing the circuit parameters Ω and T_1. Author

N64-29472 Joint Publications Research Service, Washington, D.C.

SETTLING OF THE OSCILLATION PHASE AT THE OUTPUT OF A TUNED AMPLIFIER FOLLOWING SWITCHING OF INPUT SIGNALS

N. V. Talanina *In its* Radio Eng., No. 1, 1964 17 May 1964 p 168–176 refs (See N64-29454 21-09) OTS: $3.50

The variation of the phase of the voltage at the output of a tuned amplifier following switching of signals at the input is investigated. An n-stage tuned resonant amplifier (the load is a resonant circuit) operating in the linear mode is considered. Author

N64-29473 Joint Publications Research Service, Washington, D.C.

CONCERNING THE DETERMINATI)N OF SOME TRANSISTOR PARAMETERS

F. K. Kuznetsov *In its* Radio Eng., No. 1, 1964 17 May 1964 p 177–182 refs (See N64-29454 21-09) OTS: $3.50

Forty alloy transistors and eight diffuse transistors were tested in transformer oil to measure E_s, which is called the shift voltage, and whose temperature dependence is given by the equation $E_s = U_0 - kT/q \ln I_0/I_{cs}$ where U_0 is some constant, k is Boltzmann's constant, T is the absolute temperature, q is the electron charge, I_{cs} is the collector current, and I_0 is a constant. The accuracies of the tests are noted; the equation was solved by the method of least squares; and values of I_0 and U_0 are given for various transistors. D.E.W.

N64-29474 Joint Publications Research Service, Washington, D.C.

PASSAGE OF A RANDOM PROCESS THROUGH AN INERTIALESS LOGARITHMIC DEVICE

L. Ye. Kopilovich *In its* Radio Eng., No. 1, 1964 17 May 1964 p 183–190 refs (See N64-29454 21-09) OTS: $3.50

Inertialess devices with characteristic of the form $\ln(1 + \alpha x)$ are widely used in radio. In this connection the question of the passage of a random process through a device of this type is considered, in particular, the expression for the correlation function at the output of a logarithmic device in terms of the statistical characteristics of the random process at the input. The analysis for one class of random processes is presented. Author

N64-29475 Joint Publications Research Service, Washington, D.C.

ACCURACY OF MEASUREMENT OF RADIO SIGNAL PARAMETERS BY OBSERVING THE INSTANT WHEN THE OUTPUT SIGNAL OF AN OPTIMAL RECEIVER PASSES THROUGH A SPECIFIED LEVEL

Ye. I. Kulikov *In its* Radio Eng., No. 1, 1964 17 May 1964 p 191–198 refs (See N64-29454 21-09) OTS: $3.50

Methods of estimation of parameters of radio signals received against a background of stationary random noise are discussed. The method of the absolute maximum of the output signal of an optimal receiver is compared with the more easily achieved threshold method, which is used in decision equipment. It is concluded from theoretical examination and practical trials that the threshold method gives rise to appreciable errors in comparison with an estimate by the method of absolute maximum. D.E.W.

N64-29476 Joint Publications Research Service, Washington, D.C.

AMPLITUDE LIMITER USING A TANK CIRCUIT WITH CONTROLLED ATTENUATION

N. M. Boldyrev *In its* Radio Eng., No. 1, 1964 17 May 1964 p 199–205 refs (See N64-29454 21-09) OTS: $3.50

A resonant amplitude limiter is considered whose operation is based on the properties of a tank circuit with controlled attenuation. Like automatic gain control systems, this device has selective limitation properties. Various features and possibilities of practical use are explained. D.E.W.

N64-29509* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

SUFFICIENT CONDITIONS FOR STABILITY "IN THE LARGE" OF A NONLINEAR SYSTEM OF DIFFERENTIAL EQUATIONS

Jerrold H. Suddath Washington, NASA, Sep. 1964 11 p refs (NASA-TN-D-2457) OTS: $0.50

An analytical study has been made of a problem proposed by the Russian mathematician, M. A. Aizerman. The problem, which has significance in the theory of automatic control, concerns the stability "in the large" (i.e., every motion converges to a stable-equilibrium state as time approaches infinity) of dynamic systems described by nonlinear differential equations of a particular form. In proposing the problem, Aizerman made an assertion based on a linear analogy to a nonlinear system and stated the desirability of obtaining either proof or refutation of the assertion. The purpose of this paper is to show that Aizerman's assertion is true for cases in which the region of stable gains (for the analogous linear system) has a certain property. Author

N64-29563* Arkansas U., Little Rock Graduate Inst. of Technology

A COLD ELECTRON MASS SPECTROMETRIC ION SOURCE

M. K. Testerman, B. E. Gilliland, and E. M. King [1964] 16 p refs Presented at the 12th Ann. ASTM-E-14 Conf. on Mass Spectrometry, Montreal, 7–12 Jun. 1964
(Grant NsG-260-62)
(NASA-CR-56796) OTS: $1.60 ph

A resistance-strip electron multiplier, activated by electrons from a photocathode or radioactive beta-ray emitting material, was investigated for mass spectrometric ionization applications. This multiplier was found to be useful as a source of cold electrons in a mass spectrometer only when a deflection plate was used to carry the electrons out of the magnetic field of the multiplier. Besides its use in RF mass spectrometry applications, this cold electron source can also be adapted to a time-of-flight or a magnetic mass spectrometer or for use in any ion-generation process where hot thermionic emitters create difficulties. M.P.G.

N64-29569* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

ELASTOMERIC PNEUMATIC LOGIC ELEMENTS

F. F. Batsch and J. H. Laub 1 Aug. 1962 25 p refs
(Contract NAS7-100)
(NASA-CR-58360; JPL-TM-33-92) OTS: $2.60 ph

Pneumatic logic elements offer certain advantages over their electronic counterparts for operation of computers at relatively low speeds and under difficult environmental conditions. A study of elastic diaphragms and orifices, molded in various configurations from elastomers and applied as switching elements in a pneumatic array, is described. Power loss and cost of manufacture are low, and response times are adequate for operation at relatively low speed. Elastic diaphragms lend themselves readily to modular design. Author

N64-29571* Georgia Inst. of Tech., Atlanta Engineering Experiment Station

DEVELOPMENT OF NEW METHODS AND APPLICATIONS OF ANALOG COMPUTATION Quarterly Program Report 64-2, 12 Mar.–12 Jun. 1964

F. Dixon and J. L. Hammond, Jr. [1964] 9 p refs
(Contract NAS8-2473)
(NASA-CR-58241) OTS: $1.10 ph

The current program status includes the following: (1) Preliminary experiments have been performed with the modified, direct-coupled, Guennou chopper circuit. This version of the circuit appears suitable for nonrepetitive switching applications, as in the areas of analog-computer programing. Tests have been made to determine variations in offset voltage, feedthrough, leakage, and gain with various settings of load, balance pot, and shunt resistance, for the case of either randomly selected transistors or transistors that are matched as regards drive current for minimum offset voltage. (2) A synthesis technique was developed for constructing an analog-computer circuit that will operate on gaussian white noise to produce an output process with prescribed first and second moments. (3) Certain aspects of the problems associated with processing random signals to determine their moments, as well as other useful statistical properties, were investigated. I.v.L.

N64-29593 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

ADAPTIVE SYSTEMS IN INDUSTRIAL CYBERNETICS

P. Neidhardt 21 Jul. 1964 34 p refs Transl. into ENGLISH from Messen-Steuern-Regeln (Germany), v. 6, no. 1, 1963 p 6–14
(FTD-TT-64-231/1+2; AD-446412)

A general review of cybernetics as the science of dynamic automatic controlling, stabilizing, and organizing of adaptive systems is presented. In most cases, analogies are drawn between human mental processes and the corresponding machine processes. First, the concept of adaptation in cybernetics is discussed with definitions of information reporting, data processing, and learning. Next, the arrangement of the adaptive system in cybernetics is considered, followed by a discussion of optimal value circuits in adaptive systems and of the learning matrix according to Steinbuch. M.P.G.

N64-29600 Norwegian Defence Research Establishment, Kjeller Forsvarets Forskningsinstitutt
SUBHARMONIC OSCILLATIONS IN PARAMETRIC DIODES
K. A. Ingebrigtsen 16 Apr. 1963 30 p refs
(Contract AF 61(052)-484)
(TN-7; AFCRL-63-570)

Investigation of subharmonic oscillations of order one-half and one-third in presence of a capacity with a nonlinear charge-voltage relationship of third order is made. For one-half oscillations the nonlinearity of second order is essential for the existence of the subharmonic, while the nonlinearity of third order results in a definite amplitude on the oscillation as function of frequency. For subharmonics of order one-third the third order nonlinearity is essential for existence while the second order nonlinearity does not contribute to the solution in the first approximation. For both cases the particular nonlinearity of a parametric diode is inserted and discussed. Further limitation due to the conduction properties of a diode is also considered. Author

N64-29636 Bell Telephone Labs., Inc., New York, N.Y.
MICROWAVE DIODE RESEARCH Seventh Quarterly Report, 10 Dec. 1963–9 Mar. 1964
J. C. Irvin and J. G. Josenhans 20 Jun. 1964 37 p refs
(Contract DA-36-039-SC-89205)
(Rept.-16; AD-602780)

Different structures are considered for a high-voltage (harmonic generator) GaAs varactor. The performance of each design is calculated and, for comparison, also that of an epitaxial silicon varactor. All GaAs models are found to offer substantially higher quality factors than the Si model. Parametric amplifier diodes show noise in excess of thermal noise when driven into the forward conduction region where the gain-bandwidth product and the gain stability are enhanced. On the basis of a shot noise theory, the excess noise is expected to increase linearly with the average forward current. Experimental measurements show that the shot noise in gallium arsenide diodes (both diffused and surface barrier) is within 50% of the theoretical value. However, silicon diodes show excess noise an order of magnitude larger than that predicted by the theory. Author

N64-29638 Knights (James) Co., Sandwich, Ill.
GLASS ENCLOSED MINIATURE CRYSTAL UNITS CR-(XM-29)/U Eighth Report, 1 Aug. –31 Oct. 1963
[1963] 40 p
(Contract DA-36-039-SC-81298)
(Rept.-8; AD-601229)

Data are given on units bonded with Silpaint and sealed in the miniature glass HC-26/U enclosure. The frequency range is 50 to 100 mc. Preliminary aging data are given on similar units in cold-welded metal enclosures and in soldered, nickel–silver enclosures, plated on the inside with gold. Author

N64-29640 Westinghouse Electric Corp., Baltimore, Md. Surface Div.
THE SYNTHESIS OF REDUNDANT MULTIPLE—LINE NETWORKS Second Annual Report
1 May 1964 86 p refs
(Contract Nonr-3842(00))
(WGD-38516; AD-602749) OTS: $3.00

This report is concerned with multiple-line redundancy, a means of increasing the reliability of electronic systems. It describes in detail a procedure for synthesizing redundant systems in an optimum manner. The procedure balances the reliability advantage of redundancy against the cost, weight, and power penalties it introduces. It is also applicable to other problems that require the optimization of a large number of binary decisions. The report describes a program that has been written to implement the procedure on a digitial computer. Author

N64-29642 Sylvania Electric Products, Inc., Mountain View, Calif. Microwave Device Div.
X-BAND HIGH POWER CW AMPLIFIER AND AMPLIFIER CONSOLE Third Quarterly Progress Report, 1 Jan.–1 Apr. 1964
Allan W. Scott, Norman H. Pond, Robert E. Eggers, and Robert J. Twiggs 6 Dec. 1963 51 p
(Contract DA-36-039-AMC-03334(E))
(Rept.-3; AD-443082)

Effort expended on the development of a 12.5-kw cw traveling-wave tube, covering the frequency range from 7.1 to 8.5 Gc, is described. The tube is designed as a ground station tube for satellite communications. Two tubes were constructed using a narrow bandwidth circuit, and have operated successfully. Ten kw of cw power were obtained; however, operation at this power will require minor improvements in the cooling system. Period tapering of the slow-wave structure was investigated as a means of achieving the required 26% efficiency without a depressed collector, and 35% efficiency with a depressed collector. A number of experiments were performed to evaluate this tapering and to optimize a taper for this tube. Results show that efficiency can be greatly increased by tapering on a tube having no attenuator. Also, it was experimentally verified that a taper can be designed for any traveling-wave tube in terms of the normalized traveling-wave tube parameters. I.v.L.

N64-29657 Electromagnetic Technology Corp., Palo Alto, Calif.
FREQUENCY CONVERTER UNITS FOR L-BAND, S-BAND, C-BAND, AND X-BAND Interim Development Report No. 12, 1–30 Jun. 1964
15 Jul. 1964 17 p
(Contract NObsr-89536)
(AD-602517) OTS: $1.00

Twenty D5253 mixer diodes were received, and tests have shown that the impedances are improved, the conversion loss is good, and the high-power properties are similar to the 1N53. An L-band converter, using D5253 crystals, was fabricated and tested with an actual conversion loss of 12 db and a match that nearly meets the specification at the L-band port. Apparatus for launching the local oscillator and Ka-band signals was fabricated and tested. An improved single-crystal holder for testing the D5253 diode was fabricated, tested, and is working satisfactorily. An improved high-pass filter was fabricated, tested, and is now being used. Author

N64-29661 Radio Corp. of America, Harrison, N.J. Microwave Tube Operations Dept.
A LOW-NOISE, MULTIPLE-FUNCTION, X-BAND TRAVELING-WAVE TUBE Interim Development Report, 1 Feb.–30 Apr. 1964
G. Hodowanec 29 May 1964 22 p
(Contract NObsr-87535)
(IDR-3; AD-602641)

The evaluation of the preliminary design tubes indicated that further adjustment in active helix lengths would be necessary. These changes are primarily to increase the limited output section gain, which would also improve the tube overdrive characteristic and video output dynamic range. The metal–ceramic tube noise problem was investigated, and substantial

improvements in noise performance were achieved. Two-stage secondary emission video amplifiers are capable of 1 v ± 3 db video output. Final-design tubes are under fabrication. Focus packages for these tubes have been completed and checked out for focus performance. Author

N64-29674 Joint Publications Research Service, Washington, D.C.
LOGICAL ELEMENTS OF TRANSISTORS AND TAPE-WOUND CORES [LOGICHESKIYE ELMENTY NA POLUPROVODNIKOVYKH TRIODAKH I SERDECHNIKAKH IZ PERMALLOYEVOY LENTY]
Ye. F. Berezhnoy, V. G. Mikhalev, L. L. Mokhel', and V. I. Perekatov 16 Sep. 1964 87 p refs Transl. into ENGLISH of a pamphlet in the Series Elektr. Vychislitel'nye Mashiny (Moscow), 1963 p 1–103
(JPRS-26428; TT-64-41686) OTS: $3.00

This report deals with computer elements. These topics are discussed: (1) requirements for the selection of a type of triode for the complex of core–transistor logical elements; (2) micron tape cores—the process of producing 79NM-alloy tape-wound cores and the parameters of these cores; (3) the noncoincidence valve as a storage element—principle of operation, characteristics, and the peculiarities of applying the element in logic units; (4) the coincidence valve—characteristics, and peculiarities of applying this element in logic units; (5) a powerful memory element for transmitting information to more than four logic elements, of the types referred to in (3) and (4), for branching and strengthening links, as well as for creating stroke pulses of current in the system of logic elements. In addition, the evaluation of the above-mentioned elements is discussed. I.v.L.

N64-29679 Systems Inc., Orlando, Fla.
TIGHTER TOLERANCE CRYSTAL UNITS Third Quarterly Progress Report, 15 Dec. 1963–15 Mar. 1964
S. B. Boor and R. B. Angove 15 Apr. 1964 34 p refs
(Contract DA-36-039-AMC-02335(E))
(Rept.-3; AD-602974)

The design of temperature-compensated crystal units is discussed. The networks, including both compensation and frequency adjustment features, are described. The crystal design is discussed. Characteristics of typical compensated units are described and evaluated. Author

N64-29735 Joint Publications Research Service, Washington, D.C.
THE SYNTHESIS OF CERTAIN CLASSES OF CONTROL SYSTEMS
O. B. Lupanov *In its* Probl. of Cybernetics, no. 10, 1963 10 Sep. 1964 p 98–160 refs (See N64-29733 21-20) OTS: $7.40

The problem of the synthesis of control systems is one of the basic preoccupations of cybernetics. This problem may be formulated, approximately, as follows: Given a reserve of elementary facilities (e.g., electron tube units, or relays, or subprograms, or formulas of elementary arithmetic functions, etc.), given rules for the construction of more complicated formations—circuits—from these facilities, and given a method for finding a function that is realized by a circuit, find for every function, a realization circuit. This study is limited to the realization of the functions of the algebra logic, that is, functions whose arguments may assume two values, 0 and 1, and which, themselves, may assume two values, 0 and 1. Areas of discussion concern circuits of functional elements, contact circuits, formulas, and the Π-circuits; and the obtaining of lower estimates of Shannon's function for three classes of control systems—circuits of functional elements, contact circuits, and formulas. I.v.L.

N64-29748 Stanford U., Calif. Solid-State Electronics Lab.
RESEARCH IN SYSTEMS THEORY, DEVICES, AND PHYSICAL PHENOMENA FOR MICROSYSTEM ELECTRONICS Final Technical Documentary Report, Jan. 1961–Sep. 1963
Jun. 1964 298 p refs
(Contract AF 33(616)-7726)
(SU-SEL-64-037; AL-TDR-64-81; AD-602445)

Attention was concentrated on the following: (1) theory and application of adaptive threshold elements and networks of such elements; (2) theory and fabrication techniques for new classes of solid-state components, with particular emphasis on variable-gain components for adaptive systems; and (3) the study of "hot" electrons in thin metal films. Author

N64-29756 Joint Publications Research Service, Washington, D.C.
TAPE-DRIVE UNIT FOR MAGNETIC TAPES OF THE M-2 COMPUTER
V. D. Knyazev and V. N. Sakharov 22 Sep. 1964 15 p Transl. into ENGLISH from Tsifrovaya Tekhn. i Vychislitel'nyye Ustroystva (Moscow), no. 2, 1962 p 89–97
(JPRS-26496; TT-64-41754) OTS: $1.00

The tape-drive unit moves magnetic tape under the reading end for recording in connection with directions emanating from the directive unit of the memory layout. An immediate transcription of information onto the tape and computation thereof also occur. During movement of the magnetic tape at a speed of 2 m/sec the volume of recording is 3.75 impulses per mm of tape. The time for reading or recording of one zone (512 34-class binary digits) is equal to 0.6 sec. The time needed for starting or stopping of the tape is 6 msec. A.W.

N64-29802 Brandeis U., Waltham, Mass.
THE THERMAL AND ELECTRICAL CONDUCTIVITY OF COOLING STELLAR PLASMA EMITTING NEUTRINOS Scientific Report No. 4
Ik-Ju Kang and Jack S. Goldstein 10 Jun. 1964 25 p refs
(Contract AF 19(604)-7283)
(AFCRL-64-528; AD-603868)

The contribution of the URCA process to the thermal and electrical conductivities is calculated for the cooling stellar plasma, whose mass density, ρ, is of the order of $\rho \geq 10^6$ g/cc, and the temperature of which is of the order of 10^{9} K, based on the assumption that the number of degenerate electrons is conserved in first order. The contribution is found to enhance the transport coefficients, but is negligibly small for the range of mass density 10^6 to 10^{15} g/cc. Author

N64-29809 Harry Diamond Labs., Washington, D.C.
WIEN-BRIDGE OSCILLATOR AS A LOW-FREQUENCY REFERENCE SOURCE
Klaus Sann 2 Jul. 1964 60 p refs
(HDL-TR-1112; AD-604101)

Design and performance of a Wien-bridge oscillator operating at 100 cps are presented. A frequency stability of 10^{-3} has been obtained over a temperature range from −55° to +85° C with a ±20% supply voltage change. This is one order of magnitude better than the performance of oscillators preceding this design. The use of a high-impedance RC network and field-effect transistors led to a small-sized oscillator with low power consumption (1 mw). The performance of network components subjected to 20,000 g indicates that the stability will not be degraded under shock and vibration. Author

N64-29822 Aerospace Corp., El Segundo, Calif.
OSCILLATOR STABILITY
Jean A. Develet, Jr. 26 Aug. 1964 15 p refs
(Contract AF 04(695)-269)
(TDR-269(9990)-9; SSD-TDR-64-152; AD-604687)

This paper relates the conventional definition of oscillator stability to the more fundamental frequency error process of the oscillator through an integral equation. Both short- and long-term stability are encompassed by the definition. Since in general the integral equation cannot be solved, certain frequency error processes are postulated from which the stability is derived. Author

N64-29886 Portugal Nuclear Energy Commission, Sacavem Lab. de Fisica e Engenharia Nucleares
TRANSISTORIZED CONVERTER FOR THE SYNCHRONIZATION OF INDUCTION MOTORS [CONVERSOR TRANSISTORIZADO PARA A SINCRONIZACAO DE MOTORES DE INDUCAO]
M. J. Campos Costa 1963 18 p refs In PORTUGUESE; ENGLISH summary
(LFEN.13 (α, ζ))

A system is presented that allows an ordinary induction motor, supplied by a d.c.–a.c. inverter of controlled frequency, to start in a normal way and attain synchronization of its rotor speed with a periodic reference signal (which may be derived from the line) without loss of its torque. This synchronization is maintained under normal operating conditions, and is automatically restored in the eventuality of being temporarily lost upon a sudden increase in the applied load. A low-power oscillator with a high stability (0.002%) in frequency is used as the reference signal, lending the same precision to the rotor speed. The system is entirely transistorized and has a high electrical efficiency. The control circuit uses only 2 watts. Author

N64-29928 Sperry Gyroscope Co., Great Neck, N.Y. Electronic Tube Div.
WIDE-BAND BEAM-TYPE PARAMETRIC AMPLIFIER
Griffiss AFB, N.Y., RADC, Aug. 1964 18 p
(Contract AF 30(602)-3055)
(RADC-TDR-64-280; AD-605369)

An X-band, beam-type, parametric amplifier capable of operating in a 20% instantaneous band of frequency is under development. The device is a degenerate type with the pump frequency fixed at 21 Gc. The amplifier is to have an RF gain of 25 db and a double-channel noise figure of 2 db. The device uses a modified bifilar helix as the coupler and a resonant quadrupolar circuit as the pump. Cold test data on RF match, cavity-Q, and circuit loss for the pump and coupler at their respective operating frequency ranges are presented. Best results on the coupler show that the VSWR is nominally at 2, and the cold insertion loss is about 4 db. Problems and results of the first and second devices constructed during the reporting period are discussed. The discussion includes d.c. properties of electron gun and electron beam focusing, collector operation, Kompfner dip measurements, and signal transmission from coupler to coupler. Author

N64-29931 Bay State Electronics Corp., Boston, Mass.
BS-501 HIGH-SPEED CORRELATOR Final Report
Griffiss AFB, N.Y., RADC, Aug. 1964 74 p ref
(Contract AF 30(602)-2915)
(RADC-TDR-64-158; AD-605263)

This report describes the design and development of an experimental real-time audio bandwidth (50 to 5,000 cps) correlator that will display a correlogram while operating "on line." The correlation index is displayed as a function of relative delay and time for either auto or cross correlation. The correlogram is presented as a three-dimensional display on the CRT of a self-contained oscilloscope with the X-axis presenting time, Y-axis relative delay, and Z (intensity) representing the correlation index. Signal input circuitry includes a normalizing (AGC) function with 40-db dynamic range, along with necessary gross input level controls and metering. A five-bit A to D converter drives a recirculating memory speedup system. Appropriate clock, accumulator, and computer circuits are used to approximate correlation coefficient at a real-time rate. The output D to A converter drives the Z axis of the oscilloscope to indicate the correlation coefficient. Author

N64-29964 General Electric Co., Owensboro, Ky. Tube Dept.
RESEARCH ON RADIATION-RESISTANT HIGH-TEMPERATURE THERMIONIC CIRCUITRY Technical Documentary Report, 3 Jun. 1963–May 1964
Wright-Patterson AFB, Ohio, AF Avionics Lab., Aug. 1964 153 p
(Contract AF 33(657)-11400)
(AL-TDR-64-187; AD-605312)

This report covers the developmental work, progress made, and problems encountered in designing and fabricating radiation-tolerant, high-temperature, thermionic integrated micromodule (TIMM) circuit elements and functional circuitry. The objectives of the program were to perform applied research toward the evaluation and processing of materials exhibiting stable and superior physiochemical characteristics over the temperature range up to 600° C, and to incorporate such materials into devices, modules, and integrated circuits for reliable operation in severe mechanical, thermal, and radiation environments. Functional circuits, fabricated to demonstrate feasibility of the TIMM concept, have been designed to operate at 580° C. Performance characteristics of functional electronic circuits are summarized. Author

N64-29969 Clevite Corp., Palo Alto, Calif. Semiconductor Div.
FOUR-LAYER DIODE DEVELOPMENT PROGRAM Final Report, 7 Mar. 1963–7 Mar. 1964
Walter Schroen Griffiss AFB, N.Y., RADC, Jul. 1964 130 p refs
(Contract AF 30(602)-2949)
(RADC-TDR-230; AD-605262)

This report describes the design, development, fabrication, and characterization of a high-current, high-voltage silicon four-layer diode. The main feature of the new four-layer diode is a voltage-current characteristic that is, prior to switching, similar to that of an avalanche diode. This property is achieved by short-circuiting one emitter-base junction. The short-circuiting takes place over the entire area in order to maintain uniform current conduction. Devices switching at 500 volts or higher, with peak pulse current

capability of 1,000 amperes or more, are described. Since series operation of many devices is possible without complex dividing networks, the complexity of pulse modulator circuitry is reduced, and resonantly charged circuits can exhibit a high degree of operating reliability and temperature insensitivity. Author

N64-29978 Stanford Research Inst., Menlo Park, Calif.
THIN-FILM COLD CATHODES FOR MICROWAVE TUBES
D. V. Geppert and B. V. Dore Aug. 1964 34 p refs
(Contract AF 33(615)-1345)
(IR-2; AD-603742)

Substrate work has been completed by the successful development of refractory Pt-alumina substrates that meet all substrate requirements. Work on SiO barriers has been completed, with the conclusion that such barriers are unsuitable for long-life cathodes. Unexpected problems have been encountered in realizing compound oxide barriers, but a new process has been briefly investigated that promises to solve most of the problems. The problem of high lateral resistance on evaporated Pt films has been solved. Special phototubes are under construction that will permit the work function of evaporated rare-earth boride films to be measured. The life of (Zn-Mg)O barriers is at least on the order of 1,000 hours. Author

N64-29982 Eitel-McCullough, Inc., San Carlos, Calif.
HIGH POWER X-BAND GENERATOR Quarterly Report No. 6, Jan. 1–Mar. 31, 1964
William R. Luebke, Jared Leidigh, and Tore Wessel-Berg 21 May 1964 26 p ref
(Contract AF 30(602)-2756)
(RADC-TDR-64-257; AD-604333)

The purpose of this program is to develop a klystron amplifier operating at 8 kmc and delivering 1 mw of CW power. Two long-pulse interim tubes were tested, but neither achieved significant average power levels. The development of output windows for these high-average power tubes is discussed. Test results on a short pulse tube having a two-gap penultimate cavity are summarized. Further development work on extended-interaction buncher cavities is described. A theoretical analysis of some large-signal aspects of the excitation of an extended-interaction cavity by an electron beam is included. Author

N64-29991 Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J.
CALCULATION OF INTRA-PULSE PHASE SHIFT IN LINEAR BEAM MICROWAVE TUBES
David D. Hallock Apr. 1964 21 p refs
(USAELRDL-TR-2465; AD-603712)

The intrapulse phase shift that occurs in a linear beam microwave tube, due to ion neutralization of the space charge of the electron beam, is calculated under certain simplifying assumptions. The final result, based on the well-known rate of ion formation in a gas, relates the phase change to the pulse length, gas pressure, beam voltage and current, and to the number of beam wavelengths in the interaction region. Using the theory derived, comparison of the calculated intrapulse phase shift with that observed on operating tubes indicates that this theory is accurate and that the ionization of residual gas, which results in an increase in the beam velocity, is the prime cause of intrapulse phase shift. Author

N64-29996 Stanford Research Inst., Menlo Park, Calif.
INVESTIGATION OF PROPAGATION-LIMITED COMPUTER NETWORKS Final Report
B. Elspas, R. A. Short, J. Goldberg, H. S. Stone, and R. C. Minnick Apr. 1964 128 p refs
(Contract AF 19(628)-2902)
(AFCRL-64-376; AD-603165)

This report summarizes research on techniques for the logical analysis and design of computer networks in which the propagation delays on the lines connecting logic blocks within the network are appreciable compared to the delays within the blocks. Basic techniques for the transfer of information between blocks are discussed. The problem of preserving the separation of pulses propagating in a cascade of delay elements is shown to be fundamental. Two new transfer methods, employing two-way communication between stages, are described in detail and compared with other known two-way methods. Several new methods of employing a combination of feedback and nonfeedback blocks are described. Brief consideration is given to feedback schemes for lines capable of carrying several pulses at once. New results in the theory of totally sequential (one variable changed at a time) networks are presented, and methods of exploiting such networks to simplify the decomposition of propagation-limited systems are suggested. Also discussed are communication in large systems and special logical arrays. An analogy is made between propagation-limited networks and topological graphs, and the relation between graph size (number of nodes) and maximum distance (number of connecting branches in the shortest path) between nodes is analyzed. Author

N64-30021 Raytheon Co., Waltham, Mass.
RESEARCH ON LOW NOISE CATHODE DEVELOPMENT Interim Engineering Report No. 4, 1 Feb.–30 Apr. 1964
S. R. Steele, W. Getty, S. Mao, D. Bobroff, and P. Lindsay [1964] 73 p refs
(Contract AF 33(657)-11003)
(S-660; AD-602267) OTS: $3.00

The purpose of this program is to achieve thermionic or nonthermionic emission with a low noise temperature. A vehicle for measuring the effective noise temperature of cathodes was tested. The method for changing cathodes appears to be satisfactory. A calibration curve was obtained for the Dicke radiometer. A computer program was formulated to assist in designing electron guns for use with narrow velocity-spread cathodes and has been applied to two types of cathodes. Experiments were conducted on cooled S-4 photocathodes. A tube was designed that permits forming photosurfaces on surfaces that can be cooled to very low temperatures. Author

N64-30046* Rensselaer Polytechnic Inst., Troy, N.Y.
ADAPTIVE-PREDICTIVE MODELING OF NONLINEAR PROCESSES
P. M. De Russo, R. J. Roy, R. W. Miller, and B. W. Nutting Washington, NASA, Sep. 1964 169 p refs
(Grant NsG-244-62)
(NASA-CR-86) OTS: $3.00

The key to this research is the recognition that a knowledge is required of the inputs needed to produce desired outputs, and that this determination is a pattern-recognition problem. The first process to be considered is that of a switched two-level input signal. The theory is presented with an analysis of the memory capacity and time requirement for characterizing such a process. A suggested computer structure for the process model is presented. The final chapter has a similar

presentation, but it is not restricted to the switched two-level input signal process. Conclusions are presented in equations and tables and appended material. A.W.

N64-30114 Harry Diamond Labs., Washington, D.C.
PRECISION OSCILLATORS FOR MILITARY ELECTRONIC TIMERS
J. M. Shaull 15 Jun. 1964 31 p refs
(HDL-TR-1235; AD-602791)

A need has developed for high-accuracy military electronic timers that require miniature precision audiofrequency oscillators. Usually operation is required over the temperature range of −55° to +71° C along with shock and spin accelerations up to 20,000 g. A program has recently been initiated to improve the performance of these oscillators and develop military types for current and future needs. The types of oscillators presently in use and their capabilities and limitations are discussed. Prototype oscillators of the LC, RC, and saturable-inductance types have achieved better than 0.1% stability in laboratory tests over the temperature range required. Ruggedness requirements and long-term stability are seen as the major problems. There is evidence to indicate these difficulties may be overcome with good reliability. Author

N64-30136 Ohio State U. Research Foundation, Columbus Antenna Lab.
SOME GENERAL PROPERTIES OF THE TUNNEL-DIODE-LOADED DIPOLE ANTENNA
K. Fujimoto 15 Feb. 1964 66 p refs
(Contract AF 33(657)-10386)
(Rept.-1566-8; AD-443783)

Some discussions on gain, matching, stability, and reradiation of the tunnel diode loaded dipole antennafier are presented. In an antennafier, matching concerns both gain and reradiation or backscattering, and stability should be secured under such effects as incident field strength, reflection, and coupling with the other component. Graphical determinations of stability and reradiation with some examples are given. For convenience, an enlarged Smith chart is used. A modified chart of impedance-reflection coefficients is also shown. Noise improvement factor and charts for noise performance are given. Author

N64-30138 Illinois U., Urbana Coordinated Science Lab.
A STUDY OF NONLINEAR SECOND ORDER SYSTEMS
J. K. Aggarwal Jul. 1964 96 p refs
(Contract DA-28-043-AMC-00073(E))
(R-223; AD-443855)

Nonlinear second-order systems, which are described by a pair of coupled first-order differential equations, have been studied. The behavior of trajectories in the neighborhood of a single point and the behavior of trajectories in the large have been examined. The isolated singularity at the origin for the system $\dot{x} = ax^{n_1} + by^{n_2}$, $\dot{y} = cx^{n_3} + dy^{n_4}$, where a, b, c, and d are real, and n_1, n_2, n_3, and n_4 are positive integers, has been investigated, as has the global behavior of the systems $\dot{x} = -f(x) + g(y) + p(t)$, $\dot{y} = -h(x)$ and $\dot{x} = -f(x) \pm g(y) + p(t)$, $\dot{y} = \pm h(x) - k(y) + q(t)$. Here f(x), g(y), h(x), and k(y) are polynomials of odd degree with leading coefficients positive, and p(t) and q(t) are periodic bounded functions of time. I.v.L.

N64-30162 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ONE METHOD OF INFORMATION EXTRACTION FROM COMPUTER MACHINES
V. K. Yeliseyev 28 Apr. 1964 10 p refs Transl. into ENGLISH from Automat. i Priborostr. (USSR), no. 3, 1963 p 29–32
(FTD-TT-64-236/1+2+4; AD-600616)

A description is given of the construction and operation of the Soviet digital computer "Kiev." The symbol image to be coded is written in a standard frame broken down into squares. Rows are written from left to right, columns from bottom to top. There are five elements per row and seven per column. Each symbol, therefore, is coded in the form of a 40-digit binary code. To display the symbol, the same operation is used as for coding but in reverse order. The internal memory of the Kiev contains operative and passive cells permitting the extraction of information by several methods, which are discussed. A.W.

N64-30167 Microwave Associates, Inc., Burlington, Mass.
X-BAND SOLID-STATE DETECTOR/AMPLIFIER Quarterly Progress Report, 1 Jan.–31 Mar. 1964
John J. Brule [1964] 35 p ref
(Contract DA-36-039-AMC-03274(E))
(QPR-3; AD-602485)

The components and techniques investigated have been combined to function as the microwave and IF portions of a receiver. Several possible receiver configurations were analyzed for noise figure, stability, dynamic range, tunability, bandwidth, size, weight, power consumption, feasibility, and compatibility. On the basis of this analysis three receiver packages incorporating waveguide techniques, stripline techniques, and a low noise RF preamplifier, were selected as the items that would be developed during the final phase of this program. Specifications were prepared for all major components, and initial development was started. Author

10 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands and wind tunnels); test ranges; and tracking stations. *For related information see*: 06 Auxiliary Systems.

N64-29022 Army Cold Regions Research and Engineering Lab., Hanover, N.H.
UNDERSNOW STRUCTURES: N-34 RADAR STATION, GREENLAND
Malcolm Mellor Aug. 1964 34 p refs
(CRREL-132; AD-445872)

Data previously obtained in a program of instrumentation and observation to appraise the performance of radar station N-34 built at an altitude of about 7,000 ft in the dry-snow zone of the Greenland Ice Cap are condensed and presented. The N-34 consisted of prefabricated buildings erected inside tubular corrugated-steel shells, and the whole complex was interconnected with a closed network of steel tubes. The snow cover accumulation on the abandoned station, from 1957 to 1963, of more than 20 ft is still being restrained by the structural shells. Observations of long-term effects on this unique

structure are utilized to analyze new and existing data in evaluating design concepts. Structural deformation, differential settlement, and heat loss are discussed. Author

N64-29232 Harvard Coll. Observatory, Cambridge, Mass.
HARVARD ASTRONOMICAL OBSERVATORY ANNUAL REPORT 1963
Donald H. Menzel 1963 11 p Preprint from the Rept. of the President of Harvard Coll. and Repts. of Depts., 1962–63

This report discusses a multitude of research in progress or completed, and includes the following general areas: (1) atomic physics; (2) radioastronomy; (3) optics; (4) the radio meteor project; (5) the space-radio project; and (6) solar-radio research. I.v.L.

N64-29304 Lowell Technological Inst. Research Foundation, Mass.
INSTALLATION OF FACILITIES TO BE USED IN CONJUNCTION WITH A SHOCK TUBE Final Report, 17 Apr. 1961–30 Apr. 1964
Kenneth L. Rogers Apr. 1964 17 p
(Contract AF 19(604)-8481)
(AFCRL-64-657; AD-445896)

This report describes the design, construction, and installation of a shock tube facility. The design and construction of a photographic process area are also described. The general technique of strengthening walls, protecting service lines and personnel, is illustrated. Also shown are details of a wave speed camera and its auxiliary equipment. Author

N64-29374 Radio Corp. of America, Burlington, Mass.
INVESTIGATION OF SOME ELECTRONIC AND MECHANICAL INTERFACE PROBLEMS IN THE AN/TSG-47 SYSTEM
James J. Lauginiger, Charles V. Mahlmann, Emmett H. Reid, and Herbert W. Varley Bedford, Mass., Electron. Systems Div., Jan. 1964 82 p
(Contract AF 19(604)-8020)
(ESD-TDR-64-199; AD-601853)

This report discusses certain electronic and mechanical interfaces associated with system integration and ground support of the AN/TSQ-47 air traffic control system. Problem areas are defined, and suggestions are set forth for improvement and standardization. Discussions and recommendations for meteorological equipment and a mobile runway lighting system are included. Author

N64-29442 ARO, Inc., Arnold Air Force Station, Tenn.
ROCKET THRUST STAND SIMULATION OF SPACE VEHICLE FLIGHT DYNAMICS
Richard A. Kroeger and Paul M. Beckham Arnold Eng. Develop. Center, Sep. 1964 155 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-64-163; AD-446302)

An electromechanical system is described wherein the space-vehicle rocket-motor attach point motion may be simulated. The physical dimensions of the system are small such that it may be used in conjunction with current environmental test cells. The degree of space vehicle simulation is a consequence of the limitations on the excursions of the active strut thrust stand. The resulting motion is shown to be vibratory with respect to the center of mass of the space vehicle system. The main emphasis of this work is placed on the development of the analog simulator differential equations that ultimately serve as inputs to the mechanical system. These equations produce the vehicle motion as a function of the physically measurable thrust stand quantities, indicated thrust, and motor acceleration. The development of these equations consists of elimination of the steady-state component of vehicle motion and obtaining analog stability without interfering with the motor simulation. Author

N64-29523* National Aeronautics and Space Administration, John F. Kennedy Space Center, Cocoa Beach, Fla.
FUTURE STUDIES BRANCH ACTIVITIES REPORT, FISCAL YEAR 1963
Georg von Tiesenhausen and Theodor A. Poppel 19 Aug. 1963 105 p
(NASA-TM-X-51925; TR-4-17-3-D) OTS: $9.10 ph

The purpose of this report is to fulfill the necessary requirements of communicating with the great number of organizational segments and agencies about the numerous areas of research and development, in order to establish and maintain contact, flow of information, and coordination. Thus, trends of future developments can be recognized, and study programs in the area of launch facilities, operations, and equipment can be planned ahead of time so that useful approaches are available when required. I.v.L.

N64-29629 Bendix Corp., South Bend, Ind.
A DIGITAL COMPUTER PROGRAM FOR THE PREDICTION OF LUNAR TOUCHDOWN PHENOMENA
J. L. Gibson *In its* Lunar Landing Dyn. Systems Invest. 18 Jun. 1964 10 p (See N64-29626 21-06)

The digital computer program developed for the investigation of lunar touchdown phenomena is a result of studies into the various aspects of lunar landing-gear dynamics. The program input data consist of all parameters pertinent to the vehicle geometry and lunar surface. The vehicle configuration is defined to consist of a multiple-leg geometry having inelastic upper hardpoints and any number of tripodal-type legs. The computer program is capable of handling any vehicle orientation at touchdown that will result in planar motions during the landing. P.V.E.

N64-29631 Bendix Corp., South Bend, Ind.
AN APPROXIMATE SOLUTION OF LUNAR VEHICLE LANDING STABILITY
L. H. N. Lee, R. Schoenhals, and F. Kobayashi *In its* Lunar Landing Dyn. Systems Invest. 18 Jun. 1964 13 p (See N64-29626 21-06)

The stability of one type of two-dimensional touchdown landing of a lunar vehicle is analyzed. Landing in the downhill sense is considered. The vehicle is assumed to have a landing system comprising a set of three- or four-legged landing gears. Each leg consists of an inverted-tripod arrangement of three stroking struts that contain crushable, energy-absorbing material. The type of landing considered involves only the plane motion in a symmetrical plane of the vehicle. The lunar surface is considered to be rigid, flat, and of fixed slope. It is assumed that the downhill leg makes first contact with the ground, and that the footpad remains in contact with the ground while the vehicle pivots about the point of contact. P.V.E.

N64-29632 Bendix Corp., South Bend, Ind.
EXPERIMENTAL PROCEDURES WITH A DYNAMICALLY SCALED DROP TEST MODEL
W. D. Chambers *In its* Lunar Landing Dyn. Systems Invest. 18 Jun. 1964 9 p (See N64-29626 21-06)

A brief description is presented of a drop test model (1/10-scale version of a LEM-type vehicle) and of the test procedures used in carrying out experiments. The tests were carried out with two purposes—to correlate the actual test data with that of the dynamic-model computer program, and to investigate the 3-D drop conditions in which rotation about a vertical axis was permitted. P.V.E.

N64-29633 Bendix Corp., South Bend, Ind.
COMPARISON OF EXPERIMENTAL AND THEORETICAL RESULTS
R. J. Black *In its* Lunar Landing Dyn. Systems Invest. 18 Jun. 1964 7 p (See N64-29626 21-06)

The results of detailed comparisons of the motions of a lunar-landing model obtained by drop testing and the same motions as predicted by computer are presented. Based on results analyzed to date, it is concluded that the present theoretical model and associated computer solution predict accurately the detailed motions of a lunar-landing vehicle during the touchdown period. P.V.E.

N64-29634 Bendix Corp., South Bend, Ind.
AN EXPERIMENTAL INVESTIGATION OF NON-PLANAR LANDINGS
R. J. Black *In its* Lunar Landing Dyn. Systems Invest. 18 Jun. 1964 8 p refs (See N64-29626 21-06)

An investigation to ascertain the relative severity of non-planar landings is summarized. Tests were conducted with a 1/10 dynamically scaled (LEM) model landing on a rigid surface. The model was dropped so that it impacted the surface with the model centerline aligned with the gravitational field. The vertical impact velocity was held fixed at 10 fps. The horizontal velocity was varied from 0 to 5 fps. The ground slope resulting in a transition between stable and unstable landing was determined for each velocity for yaw angles from zero to 45° in increments of 7 1/2°. The most critical landing condition occurs during plane motion of the vehicle. A stability profile based on this landing condition with variation in only the vertical and horizontal velocity is not the most critical stability profile. The most critical stability profile is one in which the yaw angle is a function of both the vertical and horizontal velocities. P.V.E.

N64-29658 Brookhaven National Lab., Upton, N.Y.
FABRICATION OF BNL STANDARD COBALT-60 SOURCE
A. Oltmann and O. A. Kuhl Feb. 1964 28 p
(BNL-848(T-334)) OTS: $0.75

The cobalt-60 gamma irradiation source consists of a strip of cobalt approximately 12-in. long, which has been doubly encapsulated in stainless steel, once before activation and again after activation. A description is given of the procedures and equipment used in the preparation and fabrication of these sources. Author

N64-29753 Atomics International, Canoga Park, Calif.
EXPERIMENTAL TESTING OF CORE COMPONENT HANDLING EQUIPMENT AND HANDLING TECHNIQUES FOR HALLAM NUCLEAR POWER FACILITY
W. A. Kaspic 15 Sep. 1964 93 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-7785) OTS: $2.00

Satisfactory operation of the core component handling equipment and handling techniques for the Hallam Nuclear Power Facility was accomplished and confirmed by a program of testing. The test results indicated that the operational techniques were safe, and that the equipment is dependable throughout its expected range of operations. Author

N64-29825 Hughes Aircraft Co., Fullerton, Calif. Communications Div.
INTEGRATED FEED AND FRONT END STUDY OF THE PSRT Final Report
Griffiss AFB, N.Y., RADC, Jul. 1964 37 p
(Contract AF 30(602)-2939)
(RADC-TDR-182; AD-604121)

This report presents results of a technical study performed to upgrade the feed and front end assembly of the Passive Satellite Research Terminal (PSRT). The study provides the techniques, design, and development data necessary to modify the existing X-band PSRT equipment to be capable of transmitting a 100-kw signal at 7.33 Gc and receiving an arbitrarily linearly polarized signal at 8.33 Gc. Author

N64-29881 France Office National d'Etudes et de Recherches Aeronautiques, Chatillon-sous-Bagneux
ONERA EQUIPMENT AND STUDIES IN THE VACUUM AND SPACE FIELDS [EQUIPMENTS ET TRAVAUX DE L'O.N.E.R.A. DANS LES SECTEURS DE RECHERCHES SUR LE VIDE ET SUR L'ESPACE]
Marcel Le Mignon [1964] 17 p In FRENCH; ENGLISH summary Presented at the 1st Intern. Congr. of Techn. of the Vacuum in Space Research, Paris, 29 Jun.–3 Jul. 1964 *Its* T.P. No. 110(1963)

The testing facilities for research in these fields have necessitated the utilization of vacuum equipment of unusual size, which is described. Some results of the operation of these facilities are presented. Some rules to aid in the design and operation of space research chambers are also presented. Author

N64-29889 General Electric Co., Philadelphia, Pa. Missile and Space Div.
EXTRATERRESTRIAL RESOURCES DEVELOPMENT AND PROPELLANT PRODUCTION
Rodney W. Johnson, Duane L. Barney, and Dandridge M. Cole 13 Nov. 1963 64 p refs

The establishment of semipermanent and permanent bases on the moon will be governed by the degree to which the lunar resources can be exploited and developed. This report pertains to extraterrestrial propellant production. Schemes are described for the extraction of water from lunar rock and for the removal of oxygen from nonwater-containing silicate minerals of the type suspected to be present on the moon. A carbon dioxide thermal-recovery process is described for water extraction; a carbon recycle system is proposed for the reduction of silicate rocks. Results of process analyses are discussed, and simple mission requirements are explored. Economic advantages are examined from the standpoint of the amount of propellant produced per pound of hardware as would be required for propellant production on the moon. I.v.L.

N64-29903 Mitre Corp., Bedford, Mass.
ENGINEERING SIMULATION OF POWERED FLIGHT
R. W. Dix Bedford, Mass., Electron. Systems Div., Jul. 1964 50 p refs
(Contract AF 19(628)-2390)
(W-06871; ESD-TDR-64-112; AD-604865)

This document describes the current effort toward establishing a workable engineering simulation of the space–ground environment applicable to a wide variety of missile and space systems. Two powered flight computer programs have evolved from this effort. This report describes the content, inputs, and outputs of each of these programs. Author

N64-29907 Massachusetts Inst. of Tech., Cambridge Operations Research Center
ORDNANCE LOGISTICS STUDIES. IV: DISCUSSION NOTES FOR OPERATING SUPPLY PERSONNEL ON MATHEMATICAL METHODS OF SUPPLY CONTROL. FUNDAMENTAL INVESTIGATIONS IN METHODS OF OPERATIONS RESEARCH
Gottfried Oppenheimer May 1963 125 p refs
(Contracts DA-31-124-ORD-14; DA-ARO(D)-31-124-G158)
(ITR-19; AROD-968-35; AD-605402)

This report is concerned with bridging the gap for the operating supply personnel of the military ordnance supply system between the supply situation—its daily crises, reports, procedures, and lack of time for reflection upon methodology—and the new, somewhat sophisticated mathematical restatements of the supply problem. Only the arithmetic of the supply analyst is used to explain the basis of the solutions offered by these mathematical representations. An illustration of the problem under ideal supply conditions—complete and accurate knowledge of future and present conditions—is given. Development of the information required in conjunction with this situation is pursued, and complicating factors are introduced. This is accomplished by building the structure of the supply system from one that supplies only one item to one customer, to one that supplies many items to many customers. Following this illustration, the discussion is extended to consider aspects of the problem under variable demand conditions. Reference is made to some of the research on the problem, and the implementations of this research are discussed. I.v.L.

N64-29932 International Business Machines Corp., Yorktown Heights, N.Y. Thomas J. Watson Research Center
COMPUTER PROGRAMMING TECHNIQUES FOR INTELLIGENCE ANALYST APPLICATION Report No. 1
Griffiss AFB, N.Y., RADC, Aug. 1964 47 p refs
(Contract AF 30(602)-3303)
(RADC-TDR-64-233; AD-605267)

This report discusses the computer program development, experimental studies, and designs of new facilities for investigations of each of the following tasks; (1) statistical prediction, discrimination, and classification technique; (2) integrated computer-oriented information retrieval techniques; (3) computer console input and display (textual and graphic); and (4) automated program debugging techniques. Author

N64-29970 Rome Air Development Center, Griffiss AFB, N.Y.
A CENTRALLY CONTROLLED INTERATIVE ARRAY COMPUTER (RADCIAC)
M. A. Knapp and D. P. Turner Jul. 1964 40 p refs
(RADC-TDR-64-251; AD-605370)

The primary objective of this report is to provide the programing reference manual for a parallel processing computer system (Centrally Controlled Iterative Array Computer). This system is the first computer capable of performing 100 simultaneous operations on different data at the same time. The parallel processing is accomplished by an array of 10 × 10 small processing modules operating under a central controller. This machine is one of the first departures from the von Neumann-type conventional computer organizations. Author

N64-29979 Naval Ordnance Lab., White Oak, Md.
MULTIPLE PISTON TWO-STAGE LIGHT GAS LAUNCHER
Robert Piacesi and Robert H. Waser Aug. 1964 20 p
(NOLTR-64-96; AD-604844)

A new method for operating light gas launchers is proposed, which provides a significant increase in velocity capability. This method, adaptable to existing launchers, makes use of a second piston in the pump tube. The additional piston provides a second compression of the gas in the pump tube, with a corresponding additional push on the projectile resulting in increased velocity. Author

N64-30029 Lincoln Lab., Mass. Inst. of Tech., Lexington
ENGINEERING Quarterly Progress Report, Division 7, 1 Mar.–31 May 1964
6 Jul. 1964 27 p
(Contract AF 19(628)-500)
(ESD-TDR-64-337; AD-602621) OTS: $2.00

Some of the principal engineering efforts from March 1, 1964 to May 31, 1964, are summarized, including these: (1) in the mechanical engineering group: paraboloidal shell analysis, development of structural-analysis computer programs, reentry physics, KC-135 airborne instrumentation, recording and optical-tracking instruments, space communications, and radar discrimination technology; (2) in the construction engineering group: radar-transmitter research facility, reentry simulating range addition, and surveys; and (3) in the control systems: the Apollo program and the antenna-system assembly. A.W.

N64-30052 State U. of Iowa, Iowa City
LAUNCHERS: RESPONSE OF A LAUNCHER UNDER STRUCTURE DURING A SIMULATED ROCKET LOADING, PHASE V, PART II
G. V. R. Reddy May 1964 91 p refs
(Contract DA-11-070-508-ORD-1232)
(Rept.-10; AD-602633)

This report considers the dynamic response of a small, tactical, rocket-launcher understructure during a simulated launch. The understructure is regarded as a flexible triangular frame that pivots about a fixed point at the rear, and is supported by springs that simulate the ground support at the front. Results of the study indicate the understructure may play an important role in the suspected balloting of a rocket on the launcher rail. Author

N64-30059 Sperry Gyroscope Co., Great Neck, N.Y. Radiation Div.
DESIGN CRITERIA STUDY FOR HIGH POWER HIGH VOLTAGE RESEARCH FACILITY Third Quarterly Report, 1 Jan.–31 Mar. 1964
Apr. 1964 78 p refs
(Contract DA-36-039-AMC-03199(E))
(EB-5296-0359-3; AD-602362) OTS: $3.00

A survey was made of the various uses of the facility in the investigation of plasma physics and the effects of the plasma phenomena. The high-voltage power supply, resonant rings, drivers, and modulators to be used in the facility have been delineated. Three modulators, three resonant rings, and two drivers will be included in the initial facility configuration. The modulators will be hard tube, soft tube, and floating deck types, and the drivers will be L-band pulsed and X-band cw types. The resonant rings will be oversized waveguide at L-band and X-band, frequencies and circular waveguide at X-band. The initial building design has been completed, and a layout is included. Author

N64-30089* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
INVESTIGATION OF S-IV ALL SYSTEMS VEHICLE EXPLOSION
J. B. Gayle Washington, NASA, Sep. 1964 53 p refs
(NASA-TN-D-563) OTS: $1.50

Investigation of the S-IV All Systems Vehicle explosion indicated the following: high explosive equivalent, 1%; fireball diameter, 380 ft; fireball duration, 11 sec; maximum fragment radius, 1,500 ft. The relatively low yield was due to substantially instantaneous ignition of the spilled propellants, which probably resulted from the extreme flammability of hydrogen. Author

N64-30184 Naval Air Turbine Test Station, Trenton, N.J. Aeronautical Turbine Lab.
AN INVESTIGATION OF THE SUPERSONIC RESEARCH CAPABILITIES OF THE NATTS ALTITUDE TEST FACILITIES. PHASE I: PRELIMINARY ENGINEERING CONSIDERATIONS
W. Richard Vollmar Jun. 1964 38 p refs
(NATTS-ATL-92; AD-443672)

An investigation was made of the supersonic flow capabilities of the NATTS altitude test facility for application to aerodynamic research and free jet air-breathing engine testing. Operation up to Mach 5.0 would be available for research, and up to Mach 2.5 for test of a turbojet engine with 170-lb/sec sea-level static airflow. Maximum ramjet engine cross sectional areas would range up to about 21 ft at Mach 5.0. Reynolds numbers per inch below 750,000 would be available from Mach 2.5 to 5.0, depending on choice of stagnation pressure and temperature. Parameter variations within design point Mach numbers of 2.5 and 3.0 are given for engine and research tunnels, respectively. Author

N64-30198 Uppsala U. (Sweden) Inst. of Physics
THE DESIGN OF A NEW EXPERIMENTAL EQUIPMENT FOR PHOTO ELECTRON MEASUREMENTS Final Technical Report, 1 Jun. 1963–31 May 1964
Kai Siegbahn [1964] 12 p refs
(Contract DA-91-591-EUC-2899)
(AD-603170)

In order to investigate the possibilities of the photoelectron method as an analytic tool for determining the relative abundance of elements, a semicircular electron spectrometer with permanent magnet pieces has been made. The pole pieces of the spectrometer have a diameter of 60 cm. Attached to the spectrometer is an evaporation chamber, which makes it possible to introduce an evaporated source into the spectrometer without exposing the source to air. The X-rays, which are used for expelling electrons from the source, are monochromatized by means of a bent crystal. It is possible to use both CuKα and MoKα radiation. The detection is made with photographic plates, and the intensity ratios are determined by counting electron tracks. Author

N64-30202 Rocketdyne, Canoga Park, Calif.
A STUDY OF THE HEAT TRANSFER CHARACTERISTICS OF HOT GAS IGNITION Quarterly Progress Report, Period Ending 31 Jul. 1964
L. W. Carlson, T. A. Coultas, L. Manson, and J. D. Seader 7 Aug. 1964 19 p
(Contract AF 04(611)-9884)
(RM-1063/362; AD-603816)

Major effort was directed toward design of a hot-gas heater, detail of test-section components, procurement of materials, and hardware fabrication. Heater fabrication is nearly finished and final assembly is underway. All test-section designs are now complete. All components are fabricated except those purposefully held back pending system checkout and analysis of initial experimental results. Author

11 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; 13 Heat Transfer and Thermodynamics; and 24 Physics, Plasma.

N64-29054 Israel Program for Scientific Translations, Ltd., Jerusalem
SUPER-HIGH FREQUENCY GAS DISCHARGES [GAZOVYI RAZRYAD NA SVERKHVYSOKIKH CHASTOTAKH]
V. E. Golant *In its* Advan. in Phys. Sci., v. 65, nos. 1–4, May–Aug. 1958 1964 p 45–93 refs (See N64-29052 21-23) OTS: $5.75

A review is presented of papers on the study of gas discharges in super-high-frequency (SHF) fields that were published from 1946 to 1957. The review includes discussions of the following areas: (1) electron velocity distribution function in SHF field—theoretical methods for studying SHF gas discharges, kinetic equation for the electron velocity distribution function, similarity principle in high-frequency discharges, electron distribution functions in constant and high-frequency fields; (2) onset of discharge under continuous application of a high-frequency field—onset of discharge in diffusion conditions, influence of a constant magnetic field on breakdown, influence of recombination on appearance of the discharge; (3) steady-state conditions of SHF discharges—high-frequency discharges in diffusion conditions, high-frequency discharges in the presence of electronegative gases; and (4) pulsed SHF discharges—conditions for breakdown under the influence of square pulses, discharge under high-power high-frequency pulses. P.V.E.

N64-29200* Delaware U., Newark
BINARY COUETTE FLOW WITH HYDROGEN INJECTION INTO CARBON DIOXIDE AND NITROGEN STREAMS
H. A. Simon, C. S. Liu, J. P. Hartnett, and C. L. Chang Jun. 1964 61 p refs
(Grant NsG-356)
(NASA-CR-58497; TR-32) OTS: $6.60 ph

This report is concerned with the injection of hydrogen into free-stream gases other than air, viz, nitrogen or carbon dioxide. The study has been stimulated by the possibility of visiting neighboring planets where a variety of different atmospheres may be encountered. The one-dimensional Couette flow model is used to simulate the two-dimensional, laminar, boundary layer. In this model, the velocity of the moving plate represents the free-stream velocity, while the distance between the plates simulates the boundary-layer thickness. Calculations performed, based on the Couette flow model for hydrogen injection into a main-stream gas of nitrogen and of carbon dioxide, predict substantial reductions in heat transfer and skin friction as the blowing parameter is increased. However, the heat-transfer ratio q_w/q_{w_o}, where q_w is the heat transfer at

the wall with blowing, and q_{w_o} is the heat transfer at the wall without blowing, exhibits erratic behavior when the wall temperature is close to the recovery temperature. Several departures from boundary-layer behavior were observed; one of the most interesting in judging the validity of the model is the occurrence of an effective Prandtl number greater than one, with the corresponding influence on the recovery factor. I.v.L.

N64-29204* Drexel Inst. of Tech., Philadelphia, Pa.
DECAY OF STRONG PLANE SHOCKS IN AN IDEAL GAS
Pei Chi Chou, Robert R. Karpp, and Lawrence J. Zajac Washington, NASA, Sep. 1964 48 p refs
(Grant NsG-270-63)
(NASA-CR-107) OTS: $1.25

An approximate analytical solution for the decay of strong plane shocks in an ideal gas is developed as the first step in the study of spherical shocks produced by hypervelocity impact. A graphical solution to the same problem is obtained by a stepwise characteristics method in order to establish a criterion with which to compare the present analytical solution. Although it is based upon certain simplifying assumptions, the analytical solution yields a good time-history representation of the shock wave phenomena in an ideal gas. For weak shocks, both the analytical and graphical solutions agree favorably with Friedrichs' solution at small values of time. By a modification of the equation of state, the approximation technique developed can be extended to other media. Author

N64-29214* Michigan U., Ann Arbor College of Engineering
LIQUID-VAPOR EQUILIBRIUM IN THE SYSTEM HYDROGEN-HELIUM
R. E. Sonntag, R. W. Crain, Jr., W. B. Street, and G. J. Van Wylen Jun. 1964 73 p refs
(Contract NAS8-5256; ORA Proj. 05864)
(NASA-CR-58687; Rept.-05864-2-F) OTS: $7.60 ph

The principal investigation of this project deals with the equilibrium in system normal hydrogen–helium, and was the subject of the doctorial thesis by W. B. Street. Since this work has been reported previously in considerable detail, it will only be reviewed in this report. Upon completion of that phase of the investigation, it was felt necessary to study this system using 20.4° K equilibrium hydrogen (0.21% ortho, 99.79% para) instead of normal hydrogen, in order to study the nature and extent of any differences between the two systems. It was not deemed necessary to make as thorough a coverage as in the first phase of the work, since the prime concern here are the differences between the two systems. Consequently, while 11 isotherms were investigated for normal-hydrogen (15.5°, 17.07°, 20.4°, 23.0°, 26.0°, 29.0°, 30.6°, 31.0°, 31.5°, 31.9°, and 32.5° K), only 6 were repeated for equilibrium hydrogen (20.4°, 23.0°, 26.0°, 29.0°, 31.0°, and 31.5° K) at pressures from hydrogen saturation to 500 psia. I.v.L.

N64-29229* MHD Research, Inc., Newport Beach, Calif.
DISTRIBUTION OF ENERGY IN A SHOCK TUBE DRIVER
T. J. Naff May 1964 29 p
(Contract NAS2-1831)
(NASA-CR-58490; MHD-652) OTS: $2.60 ph

The pressure-time history at selected positions in a high-pressure driver, and the efficiency of the energy input of the wave-heating process were determined. Electrical heating was utilized to heat a portion of a very long shock tunnel driver, and the wave motion then distributed the energy. It was indicated that if the heating times required and the wave transit times in the tube are less than 10 milliseconds, and if sufficient energy is available to allow more than 50% energy loss, then partial heating of the driver length is an acceptable method of heating a shock tube driver. I.v.L.

N64-29318 California Inst. of Tech., Pasadena Hydrodynamics Lab.
GRAVITY WAVES DUE TO A POINT DISTURBANCE IN A PLANE FREE SURFACE FLOW OF STRATIFIED FLUIDS
C. C. Mei and T. Yao-Tsu Wu Apr. 1964 50 p refs
(Contract Nonr-220(43))
(Rept.-97-5; AD-442126)

The fundamental solution of the gravity waves due to a two-dimensional point singularity submerged in a steady free surface flow of a stratified fluid is investigated. A linearized theory is formulated by using Love's equations. The effect of density stratification $\rho_0(y)$ and the gravity effect are characterized by two flow parameters $\sigma = -(d\rho_0/dy)/\rho_0$ and $\lambda = gL/U^2$, where $\lambda^{-1/2}$ may be regarded as the internal Froude number if L assumes a characteristic value of σ^{-1}. Two special cases of σ and λ are treated. Author

N64-29320 Electro-Optical Systems, Inc., Pasadena, Calif.
EFFECT OF BOUNDARY LAYER BLOWING ON THE LAMINAR SEPARATED SHEAR LAYER
Eric Baum Apr. 1963 56 p refs
(Contract DA-04-495-AMC-28(Z); ARPA Order 203-A1-63; Proj. Defender)
(EOS-RN-9; AD-406698)

The laminar, separated, shear-layer profiles have been calculated for initial conditions corresponding to similar blowing from the body surface. The results are presented in graphical and tabular form. The application of these results to the laminar base flow indicates that blowing into the body boundary layer due to ablation of the wall has a significant effect on base flow properties, causing an increase in the length of the separated shear layer and in the base pressure, and a decrease in the dividing streamline velocity, thereby recirculating region core enthalpy, and dividing streamline stagnation enthalpy. Author

N64-29321 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE HYDRODYNAMICS OF AN EXPLOSION
Yu. S. Yakovlev 12 Sep. 1963 343 p refs Transl. into ENGLISH of the book "Gidrodinamika Vzryva" Leningrad, Gos. Soyuzn. Izd. Sudostroit. Prom., 1961 p 1–313
(FTD-TT-63-381/1+2; AD-420605)

This book is concerned with the problem of external forces and with problems involving the action of an explosion on a structure. The general laws governing the propagation of shock waves are discussed. Also discussed are explosion in an unbounded medium and the simplest boundary problems of the explosion theory. The principal aspects of the problem of external forces in the cases of aerial and underwater explosions are described. I.v.L.

N64-29338* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
BOUNDARY LAYERS ON ROTATING SPHERES AND OTHER AXISYMMETRIC SHAPES
Jay Fox Washington, NASA, Sep. 1964 12 p refs
(NASA-TN-D-2491) OTS: $0.50

Most of this report is concerned with the laminar boundary layer on a rotating sphere in a fluid at rest. The existing controversy as to the behavior of the boundary layer near the

equator is examined in the light of the governing equations. Errors were found in one group of previous solutions. A new series solution that agrees with existing experimental results provides a comparison with the consequences of the erroneous solutions. The new solution is so formulated that boundary layers on many axisymmetric shapes with conical tips (including spheres) can be calculated. Numerical values of four orders of series functions are given. Author

N64-29377 Tokyo U. (Japan) Aeronautical Research Inst.
QUASISIMILAR SOLUTIONS OF BLAST WAVES
Koichi Oshima Mar. 1964 18 p refs *Its* Rept. No. 386 (v. 29, no. 8)
(Rept.-386)

The quasi-similarity theory, which is useful to predict the flow pattern of blast waves with moderate strength, is introduced, and detailed calculations are carried out. Based on these results, an approximate formula is presented by which structures and propagations of the blast waves are described analytically. The results are compared with other theoretical and experimental data, and the validity of this theory is discussed. Author

N64-29378 Gt. Brit. Ministry of Aviation, London Technical Information and Library Services
MIXING OF JETS IN A CHANNEL OF VARIABLE CROSS SECTION [SMESHENIE STRUI V KANALE S PEREMENNYM POPERECHNYM SECHENIEM]
O. V. Yakovlevskii Jul. 1964 11 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr., v. 1, 1962 p 66–72
(TIL/T-5410)

An attempt is made to evolve a method of calculating the flow parameters of a liquid with an irregular velocity distribution, of jet type, in a channel of variable cross section. An equation is derived to describe the automodel similarity distribution of the velocity. With assumptions of incompressibility, constant static pressure, and negligible fluid–wall friction, the problem reduces to determining the relationships of three unknowns. Comparison of theoretical and experimental results show the applicability of the method for converging channels with rectilinear generators. Author

N64-29429 Ohio State U. Research Foundation, Columbus
THE DESIGN AND CONSTRUCTION OF A LUMINOUS SHOCK TUBE FOR SPECTROSCOPIC INVESTIGATIONS OF HIGH-TEMPERATURE GASES Final Report
Paul L. Byard, Ronald E. Roll, and Arne Slettebak Jan. 1964 25 p refs
(Contract AF 19(604)-4055)
(AFCRL-64-257; AD-602077)

A shock tube was constructed for use in experiments pertaining to the calculation of experimental absolute atomic oscillator strengths (quantities that express the preference of an atom to absorb or to emit a given radiation frequency). This tube of stainless-steel consists of two basic sections—a 5 3/4-inch I.D. "compression" chamber that tapers down to meet a 20-inch I.D. 13-foot-long "expansion" chamber. A detailed description of this shock tube was given in a previous paper; therefore, this report places emphasis on the modifications and additions to the equipment. In addition, the theory of the formation of spectrum lines, applicable to shock-tube spectroscopy, is developed, and a temperature behind the reflected shock wave is computed by a line-reversal method. The temperature measured was in good agreement with previously measured excitation temperatures. I.v.L.

N64-29502 Massachusetts Inst. of Tech., Cambridge Aeroelastic and Structures Research Lab.
THE STABILITY OF LAMINAR INCOMPRESSIBLE BOUNDARY LAYERS IN THE PRESENCE OF COMPLIANT BOUNDARIES
Richard E. Kaplan Jun. 1964 191 p refs
(Contract Nonr-1841(89))
(ASRL-TR-116-1; AD-601779)

A numerical technique has been developed for the solution of the Orr–Somerfeld equation for a boundary layer flowing over a general class of compliant boundaries. Sample calculations are worked out in detail for several types of models of compliant boundaries. It is shown that a compliant boundary can have a significant influence on the stability of the laminar boundary layer, both by delaying the appearance of unstable disturbances until higher values of the Reynolds number and by reducing the total spatial amplification of any frequency band. The general requirements for materials of the boundary are that the equivalent shear modulus should be of the order of the dynamic pressure, the density of the order of the density of the fluid in the boundary layer, the thickness should be large compared to that of the boundary layer, and there should be as little dissipation as possible in the boundary. Author

N64-29524 General Electric Co., Philadelphia, Pa. Missile and Space Vehicle Dept.
A DISCUSSION OF NESS'S ANALYSIS FOR A TURBULENT BOUNDARY LAYER WITH MASS ADDITION
G. K. Walker and B. A. Schumann [1960] 37 p refs
(Contract AF 04(647)-715)
(Rept.-61SD49; AD-600627) OTS: $2.00

The governing equations of Ness's analysis of the turbulent boundary layer with air injection have been solved by means of a digital computer. The results of the calculations are presented for various free-stream and local conditions. The results of Ness's analysis for air injection are compared with experimental data, and agreement is poor. A comparison of Ness's theory with incompressible velocity profile data provides a possible explanation for the discrepancy. A comparison of Ness's analysis for helium injection and experimental data shows good agreement for zero to moderate injection rates, and poor agreement for high injection rates. Author

N64-29532 Wisconsin U., Madison
A CRITICAL INVESTIGATION OF THE UNIVERSALITY OF KARMAN'S CONSTANT IN TURBULENT FLOW
Larry S. Slotta *In its* Studies of the Effects of Variations in Boundary Conditions on the Atmospheric Boundary Layer Nov. 1963 p 1–36 refs (See N64-29531 21-21)

The aim of this study was a basic examination of von Kármán's constant. A literature review revealed essentially three methods of determination for this semiempirical value: (1) that sought by the statistician on the basis of decay of turbulent energy; (2) that found by the slope of the logarithmic plot of nominal height versus dimensionless velocity (thus assuming a logarithmic velocity distribution); and (3) that determined from approach of a limiting wall condition for an explicit function described by the structure of the flow.

Author

N64-29622 General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.
A PROGRAM OF TWO-PHASE FLOW INVESTIGATION Second Quarterly Report, Jul.–Sep. 1963
F. W. Staub and N. Zuber Oct. 1963 96 p refs
(Contract AT(04-3)-189)
(GEAP-4367) OTS: $2.25

The work described represents a joint U.S.–Euratom effort. It includes the following achievements: (1) The experimental loop is completed with the exception of the insulation of modified components. The system was charged with Refrigerant-22, and preliminary loop-performance tests were completed without the test sections. (2) The stainless-steel test section has been prepared, complete with end flanges and pressure tap locations. (3) The mechanical design and drafting of the structural components of the test stand and of the drive system is complete. (4) Void-fraction-detector instrumentation has been acquired, and both collimators and the detector cooler are being constructed. (5) Bridge circuits for the temperature transducers have been designed, and their fabrication is in process. The preamplifiers and the power supply for these transducers have been acquired. (6) Evaluation tests of samples of two pressure transducers are more than 80% complete. (7) The breadboard power circuit is 70% complete, and component design and rack layout is about 90% complete. A breadboard of the control circuit is practically complete. (8) Two problems dealing with the destabilizing effects of heat addition on the two-phase flow and on the flow patterns were analyzed. I.v.L.

N64-29649 Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
STUDY OF INFRARED EMISSION FROM HYPERSONIC AIR FLOWS Semi-Annual Report
Walter H. Wurster Jul. 1964 49 p refs
(Contract DA-30-069-ORD-3443; ARPA Order 253-62; Proj. Defender)
(CAL-QM-1626-A-15; AD-443042)

An account is presented of the research accomplished on radiation measurements and reentry flow-field analysis. Shock-tube radiation measurements have been begun on air and other N_2-O_2 mixtures covering the wavelength range 3,500 to 9,500A and temperatures as low as 2,500° K. The experiments are planned to determine the effects of NO_2, NO, and N_2 in contributing to the radiation from shock-heated air. Recent modifications of the bow shock program are described. An approximate afterbody program, utilizing a previously developed nozzle calculation, is discussed briefly. An investigation of two alternate methods of calculating afterbody flows is given. Author

N64-29671 Ling-Temco-Vought, Inc., Dallas, Tex. Research Center
EXPERIMENTAL INVESTIGATION OF THE COMPRESSIBLE TURBULENT BOUNDARY LAYER AT VERY HIGH REYNOLDS NUMBERS, M = 2.8
D. R. Moore and J. Harkness Apr. 1964 40 p refs Presented at the AIAA Transport Aircraft Design and Operations Meeting, Seattle, 10–12 Aug. 1964
(Rept.-0-71000/4R-9)

Results are given of two series of tests in which local surface shear stress and boundary-layer velocity profile measurements were made on aerodynamically smooth, isobaric, adiabatic surfaces. The tests were conducted in the high-speed wind tunnel at a nominal Mach number of 2.8. In the first series, a 10-ft-long flat-plate model served as the test surface. In the second series, the floor of the tunnel supersonic diffuser, modified to provide an effective extension of the tunnel test section, was the test surface. A description is presented of the test apparatus and procedures. The program objective was accomplished in that a Reynolds number range of $2.32 \times 10^7 \leq R_x \leq 1.41 \times 10^9$ was covered. Author

N64-29672 Lockheed-Georgia Co., Marietta
ANALYSIS OF THERMAL STRATIFICATION OF LIQUID HYDROGEN IN ROCKET PROPELLANT TANKS
J. W. Tatom, W. H. Brown, L. H. Knight, and E. F. Coxe [1963] 27 p refs
(ER-6759)

The test program was conducted to provide information on the nature of stratification and to support the analysis. The analytical study, which involved the definition of two empirical constants, was directed toward obtaining a realistic mathematical model of stratification. The results of the study indicate that the developed analytical model can adequately predict stratification effects in liquid hydrogen. Author

N64-29692* Ohio State U. Research Foundation, Columbus Antenna Lab.
TWO SCATTERING PROBLEMS INVOLVING MOVING MEDIA
Chen To Tai 30 May 1964 17 p refs
(Grant NsG-448)
(NASA-CR-58565; Rept.-1691-7) OTS: $1.60 ph

Two scattering problems involving moving media are studied. The first deals with the reflection of a plane electromagnetic wave from a semi-infinite moving medium. The second is an investigation of the scattering field from a rotating dielectric cylinder. The formulation is based upon the Maxwell–Minkowski equations, which are accurate to the order of v/c, where v denotes the velocity of a moving medium and c the velocity of light. Author

N64-29694* Ohio State U. Research Foundation, Columbus Antenna Lab.
A STUDY OF ELECTRODYNAMICS OF MOVING MEDIA
Chen To Tai 31 Jan. 1964 23 p refs
(Grant NsG-448)
(NASA-CR-58561; Rept.-1691-4) OTS: $2.60 ph

This study contains a digest of Minkowski's theory of electrodynamics of moving media in the three-dimensional form and a critical review of some current writings on this subject from the point of view of Minkowski's theory. The invariant nature of the Maxwell–Minkowski equations is explained in terms of a conventional language. The important role played by the constitutive relations in formulating a complete theory of electrodynamics of moving media is pointed out. Author

N64-29696* Avco-Everett Research Lab., Everett, Mass.
A MULTITEMPERATURE BOUNDARY LAYER
Morton Camac and Nelson H. Kemp Aug. 1964 24 p refs
(Contract NASw-748)
(NASA-CR-58759; Avco-Everett Res. Rept.-184) OTS: $2.60 ph

This is a preliminary report on an analytical investigation of the end wall boundary layer behind a reflected shock in a shock tube in highly ionized argon. Two nonequilibrium effects are considered: (1) chemical nonequilibrium because of finite recombination rates; and (2) lack of equilibrium between electron and heavy (atom and ion) particle temperatures because of a finite rate of energy exchange by elastic collisions between electrons and ions. The coupling between the electrical and the aerodynamic effects is considered simultaneously. The boundary layer is divided into two regions. Near the wall there is a plasma sheath whose thickness is several Debye lengths. The Debye length is small compared to the boundary-layer thickness. Outside the sheath, in the aerodynamic boundary layer, the usual continuum fluid mechanics treatment is used. These two descriptions of the plasma are joined at the sheath

edge by requiring continuity of ion mass flux and electron energy flux, which serve as boundary conditions for the continuum boundary-layer equations. Author

N64-29712 California U., La Jolla
THE INHOMOGENEOUS ELECTRON GAS
P. Hohenberg and W. Kohn 17 Jun. 1964 25 p refs Partially Supported by ONR
(TR-23; AD-602040)

This paper deals with the ground state of an interacting electron gas in an external potential, $v(\underline{r})$. It is proved that there exists a universal functional of the density, $F[n(\underline{r})]$, independent of $v(\underline{r})$, such that the expression $E \equiv \int v(\underline{r})\, n(\underline{r})\, d\underline{r} + F[n(\underline{r})]$ has as its minimum value the correct ground state energy associated with $v(\underline{r})$. The functional $F[n(\underline{r})]$ is then discussed for two situations: (1) $n(\underline{r}) = n_0 + \tilde{n}(\underline{r})$, $\tilde{n}/n_0 << 1$ and, (2) $n(\underline{r}) = \phi(\underline{r}/r_0)$ with ϕ arbitrary and $r_0 \to \infty$. In both cases F can be expressed entirely in terms of the correlation energy and linear and higher order electronic polarizabilities of a uniform electron gas. This approach also sheds some light on generalized Thomas–Fermi methods and their limitations. Some new extensions of these methods are presented. Author

N64-29715* Maryland U., College Park Inst. for Molecular Physics
INTERACTION ENERGIES, CHARGE EXCHANGE CROSS SECTIONS, AND DIFFUSION CROSS SECTIONS FOR N^+–N AND O^+–O COLLISIONS
Hans Knof, E. A. Mason, and J. T. Vanderslice Repr. from J. Chem. Phys., v. 40, no. 12, 15 Jun. 1964 p 3548–3553 refs
(Grant NsG-5-59)

Potential energy curves for the lower electronic states of the N_2^+ and O_2^+ molecules have been obtained from a semi-empirical valence bond method that makes use of available spectroscopic data. From these curves the probability of charge exchange has been calculated, and from this the charge-exchange and diffusion cross sections. The cross sections for the O^+–O collisions are in good agreement with the experimental values of Stebbings, but differ by about a factor of 3 from earlier theoretical estimates. Some consequences of this are discussed. Author

N64-29750 General Electric Co., Philadelphia, Pa. Missile and Space Div.
THE GROWTH OF LAMINAR BOUNDARY LAYERS WITH ZERO PRESSURE-GRADIENT
George K. Walker 30 Jan. 1963 10 p refs
(TFM-8151-008)

The results presented are strictly applicable for the case of a flat plate, cone, or cylinder with constant pressure and wall temperature. However, for cases where the pressure gradient and wall temperature gradient are small, the present results should provide adequate approximations. Attempts have been made to account for real gas effects throughout each step in the analysis. Estimates of mass addition effects have been made for the case of air, only. However, the results should be approximately correct for coolant gases whose properties are not greatly different from those for air. Author

N64-29798 Pennsylvania State U., University Park
CHEMICAL KINETICS AND HYPERSONIC FLOW
Howard B. Palmer Aug. 1964 29 p refs Presented at the Intern. Symp. on Fundamental Phenomena in Hypersonic Flow, Buffalo, 25–26 Jun. 1964
(Contract Nonr-3623(00); Proj. Squid)
(PSU-11-P; AD-605000)

Shock-tube studies relating to the following areas are reviewed: (1) The Dissociation of Diatomic Molecules and the Recombination of Atoms—The theory of dissociation rates is discussed as well as the dissociation rates for various diatomic molecules and the recombination of various atoms. It is pointed out that no case can be found in which atom recombination has been studied at the same temperature as that of the molecular dissociation. (2) The Chemical Kinetics of Air—Discussed are vibrational relaxation; dissociation of diatomics and recombination of atoms, for N_2, O_2, and NO; the "shuffle reactions," $O + N_2 \rightleftarrows NO + N$ and $N + O_2 \rightleftarrows NO + O$; the bimolecular route to nitric oxide, $O_2 + N_2 \rightleftarrows 2NO$; and the formation of ionized nitric acid, $N + O \to NO^+ + e$. (3) The Thermal Decomposition of Hydrazine—The mechanism of hydrazine decomposition is explained by the following consecutive steps: $N_2H_4 \to 2NH_2$ (initiation), $NH_2 + N_2H_4 \to NH_3 + N_2H_3$ (propagation), and $2N_2H_3 \to 2NH_3 + N_2$ (terminal). (4) The Thermal Decomposition of Hydrocarbons—The mechanism for the pyrolysis of C_2H_2 is described. I.v.L.

N64-29815 Brown U., Providence, R.I. Applied Mathematics Div.
ON THE PROPAGATION OF FREE SOUNDWAVES IN RAREFIED GASDYNAMICS
Lawrence Sirovich and James K. Thurber Jul. 1964 44 p refs
(Contract Nonr-562(07))
(Rept.-562(07)/58; AD-604482)

A theory of sound propagation, employing general kinetic models, in an unbounded medium is presented. Numerical results for rigid sphere and Maxwell gas models are obtained; these are compared with already existing theories. Author

N64-29816 Brown U., Providence, R.I. Applied Mathematics Div.
ON THE PROPAGATION OF FORCED SOUNDWAVES IN RAREFIED GASDYNAMICS Technical Report No. 59
Lawrence Sirovich and James K. Thurber Aug. 1964 30 p refs
(Contract Nonr-562(07))
(Rept.-562(07)/59; AD-604481)

A kinetic theory description of sound propagation in a simple gas is presented. The results are in very close agreement with experiment through all values of Knudsen number. Author

N64-29821 Aerospace Corp., El Segundo, Calif. Aerodynamics and Propulsion Research Lab.
NEWTONIAN FLOW OVER A STATIONARY BODY IN UNSTEADY FLOW
J. W. Miles 3 Aug. 1964 19 p ref
(Contract AF 04(695)-269)
(TDR-269(4230-30)-6; SSD-TDR-64-146; AD-604892)

The equations governing either two-dimensional or axisymmetric, unsteady hypersonic flow over a stationary body are developed on the hypothesis of a thin shocklayer. These approximate equations are integrated to obtain a formal generalization of the Newton–Busemann formula for the pressure on the body. It is found that, just as in steady flow, tangential velocity, integrated mass flux, and entropy are

conserved by fluid particles within the shock layer; however, retarded-time effects render specific applications more complicated. Author

N64-29864 Naval Ordnance Lab., White Oak, Md.
CHAPMAN-JOUGUET PRESSURES OF SEVERAL PURE AND MIXED EXPLOSIVES
N. L. Coleburn Sep. 1964 19 p refs
(NOLTR-64-58; AD-603540)

The Chapman–Jouguet pressures and reaction product isentropic exponents of 15 pure and mixed explosives were measured. Smear camera shadowgraphs were made of cylindrical shock waves that these explosives transmit into water. From these measurements and the water shock Hugoniot, the coordinates of the intersection point were determined in the pressure-velocity plane between the water shock wave and the rarefaction wave reflected back into the detonation products. The isentrope passing through the Chapman–Jouguet pressure-volume point was obtained assuming the products obey a polytropic equation of state (PV^k = constant). Author

N64-29868 Army Materiel Command, Hanover, N.H. Cold Regions Research & Engineering Lab.
FORCES ON A SPHERE ACCELERATING IN A VISCOUS FLUID
Fuat Odar Mar. 1964 34 p refs
(RR-128; AD-602777)

A study of the determination of the forces exerted by a fluid due to the relative velocity and acceleration of a sphere is presented, and previous work on rectilinear motion of bodies in a still fluid and the rectilinear motion of a fluid past fixed objects is reviewed. Experimental procedure, equipment, and tests are described. A formula is given for determining the resisting forces acting on a sphere moving rectilinearly in a viscous fluid, in terms of sphere radius, fluid density and viscosity, object velocity in the fluid, object acceleration, and force coefficients. The latter were determined experimentally by measuring the forces on a sphere moving sinusoidally within the range of $0 < Re$ (Reynolds number) < 62. Author

N64-29876 Wisconsin U., Madison Mathematics Research Center
FOURIER ANALYSIS METHOD FOR NUMERICAL SOLUTION OF NAVIER-STOKES EQUATIONS
R. Manohar and A. Sakurai May 1964 46 p refs
(Contract DA-11-022-ORD-2059)
(MRC-479; AD-603289)

Solutions of the initial-value problem of nonstationary Navier–Stokes equations for the flow of viscous incompressible fluids with given initial conditions are obtained. The flow is assumed to be periodic in space variables in the entire space. The solution is first expressed in Fourier series whose coefficients (which are functions of time) are then obtained from a set of simultaneous ordinary differential equations by numerical methods. Different initial conditions for both two- and three-dimensional problems are considered. Results showing the behavior of some of the Fourier coefficients with time, as well as the space averages of kinetic energy and vorticity, are given for three different problems. Author

N64-29902 Toronto U. (Canada) Inst. For Aerospace Studies
A DIGITAL COMPUTER PROGRAM FOR CALCULATING NONEQUILIBRIUM EXPANSION FLOWS OF DISSOCIATED OXYGEN AND IONIZED ARGON AROUND A CORNER
J. Galipeau and A. Takano Aug. 1963 70 p refs Supported by AFOSR, CNRC, and DRB
(UTIAS-TN-69; AFOSR-64-0075; AD-444622)

The procedure of calculation is based on the numerical-graphical method of characteristics. An overall flow chart of the program is included to indicate clearly the sequence of logical and arithmetic tasks that the program performs. A listing of the program is also given to reveal fully its sequence of commands and operations. The program is divided into five phases. The first two phases designate the input data, which contain the statement of the free-stream values and the prescribed wall deflection angle as well as the control of calculation and printing. In the subsequent phases calculations are performed to derive the flow quantities. There is rarely any need to print all the results computed, and therefore only the flow quantities required to adequately indicate the current flow properties are printed at appropriately selected points on chosen characteristic lines. The skipping or printing is controlled by the input data. Author

N64-29916 Yale U., New Haven, Conn.
SURFACE TENSION OF LIQUIDS FROM WATER BELL EXPERIMENTS
Peter P. Wegener and J. Yves Parlange 6 Aug. 1964 20 p refs
(Contract Nonr-609(47))
(Rept.-3; AD-444547)

Experiments on surface tension of water obtained with dynamic techniques are briefly reviewed. The strongly anomalous results obtained with water bells are, so far, acceptable. It is shown that these experiments can also be interpreted without resorting to the concept of dynamic surface tension. This is accomplished by including a pressure differential term in the equation of motion of the bell. It is concluded that, aside from the very rapid effect of dipole relaxation, there is no current evidence on the existence of the phenomenon of dynamic surface tension for water and some other pure liquids. Author

N64-29963 Polytechnic Inst. of Brooklyn, N.Y.
LAMINAR BOUNDARY LAYERS WITH CHEMICAL REACTIONS
Herbert Fox Jun. 1964 65 p refs
(Grant AF-AFOSR-62-409)
(PIBAL-835; AFOSR-64-1394; AD-605321)

A complete discussion of the chemically reacting laminar boundary layer is presented. Included in the study are separate homogeneous and heterogeneous reactions; also considered is the problem of simultaneous gas phase and wall reaction. The basic solution, under conditions of unit transport properties (i.e., mass density–viscosity product constant, Prandtl number, and Schmidt unity) were derived using previously devised operator techniques. For gas phase reaction the solution for the species distribution reduces to an integral equation; the temperature is given by quadrature. Simple first-order results for chemistry of the usual complexity occurring in hypersonic boundary-layer flows can be obtained without resorting to large-scale computation. The flow over a catalytic wall is derived from unit solutions to the basic problem. Using the present techniques any distribution of wall catalycity is permissible, including discontinuities. Author

N64-30008 Massachusetts Inst. of Tech., Cambridge Fluid Dynamics Research Lab.
THE CALCULATION OF TWO- AND THREE-DIMENSIONAL INVISCID UNSTEADY FLOWS BY THE METHOD OF CHARACTERISTICS Final Scientific Report

Harry Sauerwein Jun. 1964 202 p refs *Its* Lab. Rept. 64-4
(Grant AF-AFOSR-156-64)
(AFOSR-64-1055; AD-605324)

The problem of the numerical solution by the method of characteristics of the two- and three-dimensional flow of an inviscid nonequilibrium gas is formulated. For unsteady flows the method is limited, for practical reasons, to the solution of hypersonic or other flows that have short transient times. The specific details of the finite difference network to be used and the associated finite difference equations are presented. It was found that numerical instability was possible with certain previously proposed networks. An existing stability criterion was found to apply to the multidimensional method of characteristics, and this criterion was used to synthesize a stable finite difference network. Author

N64-30024 Battelle Memorial Inst., Columbus, Ohio
EXPERIMENTAL AND THEORETICAL STUDIES OF FISSION-PRODUCT DEPOSITION IN FLOWING HELIUM
Gilbert E. Raines, Arnold Abriss, David L. Morrison, and Robert A. Ewing 21 Aug. 1964 42 p refs
(Contract W-7405-ENG-92)
(BMI-1688) OTS: $1.00

Deposition of fission products from helium gas streams at high temperatures and flowing at high velocities was experimentally measured in an out-of-pile loop of stainless steel. Gamma-emitting fission products evolved from mildly irradiated UC_2 fuel elements and deposited in significant quantities included I^{131}, Te^{132}, Te^{129}, Cs^{137}, $Zr\text{-}Nb^{95}$, $Ba\text{-}La^{140}$, Ce^{141}, and Ru^{103}. Deposited fission products were determined by a least-squares computer analysis procedure developed to analyze the gamma spectra obtained on small sections of the loop. Theoretical correlation of the experimental data showed that deposition in isothermal regions can be represented reasonably well by finite-difference solutions of the diffusion equation allowing for flow and a linearized adsorption reaction at the wall. Deposition of iodine did not conform to the generalized theories applicable to other fission products. Author

N64-30044 Boeing Co., Seattle, Wash. Mathematics Research Lab.
THE EQUILIBRIUM FLOW OF AN IDEAL DISSOCIATING GAS OVER A CONE
F. Edward Ehlers and Thomas A. Bray Apr. 1964 69 p refs *Its* Math. Note No. 350
(DI-82-0350; AD-602352) OTS: $3.00

The ordinary differential equations are derived for the axially symmetric flow over a cone of the Lighthill ideal dissociating gas under thermodynamic equilibrium. By means of trigonometric transformations, the equations are simplified to forms containing only rational functions. The equations are integrated numerically by a fourth-order Runge–Kutta method, and a program listing in Fortran is included. Tables of pressure, temperature, fraction of dissociation, and cotangent of the local Mach angle on the solid cone boundary are tabulated for free flight at Mach numbers of 8, 10, 12, and 14 in an atmosphere of pure oxygen corresponding to altitudes of 20,063, 32,163, and 47,350 m, and for shocks having a tangent of the cone half angle varying from 0.4 to 1.22. The results are compared with calculations for the ideal perfect gas with a ratio of specific heats $\gamma = 4/3$. Author

N64-30054 Technische Hochschule Stuttgart (W. Germany) Inst. für Aerodynamik und Gasdynamik
EXPERIMENTAL INVESTIGATIONS OF VORTEX OCCURRENCE AT TRANSITION IN UNSTABLE LAMINAR BOUNDARY LAYERS Final Report
Franz X. Wortmann 10 Feb. 1964 34 p refs
(Contract AF 61(052)-220)
(AFOSR-64-1280; AD-602796) OTS: $2.00

The behavior of laminar and unstably stratified boundary layers toward three-dimensional perturbations, in the form of vortices parallel to the direction of flow, was investigated by means of a water tunnel of very low turbulence. The artificially created vortex perturbations were photographically recorded by means of the tellurium method. The distribution of the perturbation amplitude for different wavelengths and wall distances and the growth of the vortices in the direction of flow were investigated. These experiments verify the theory of stability and show that the validity of the theory is limited to small perturbation amplitudes. Author

N64-30070 Bureau d'Analyse et de Recherche Appliquees, Issy-Les-Moulineaux (France)
ANALOG STUDY OF IMMERGED PROFILES IN PROXIMITY OF THE FREE SURFACE WITH A SUPERIMPOSED LOAD DISTRIBUTION Final Report
30 Dec. 1962 55 p refs
(Contract N-62558-2545)
(AD-296991)

A continuous, irrotational, two-dimensional flow, limited by a free surface, is considered. The fluid is assumed to be incompressible, ideal, and viscous. The complex flow-potential can be written as: $F(z) = Voz + f(z) = \Theta + i\,\Psi$ where Vo represents the velocity of the uniform flow at upstream infinity and f(z) represents the complex perturbation potential. The stream function $\Psi = Voy + \psi$ is considered where ψ represents the stream perturbation which is, as Ψ, a harmonic function. This means that the ψ potential satisfies the equation $\delta^2\psi/\delta x^2 + \delta^2\psi/\delta y^2 = 0$. Generalities on the linear theory of small perturbations for a flow limited by its free surface and the condition that takes into account the characteristics of the flow at upstream of the profile are considered. Since the condition at the free surface is difficult to represent from an analog point of view, the problem was changed into an inverse problem and was solved by the following computational processes: (1) computation of the free surface for the chosen vortices distribution and for a given flow; (2) determination of the mean line of the profile before the vortex distribution and the free surface of (1); (3) analog determination of the free surface for the chosen sinks and sources distribution for a given flow; and (4) analog determination of the shape of the profile that corresponds to (3). I.v.L.

N64-30071 Gt. Brit. Ministry of Aviation, Mottingham Technical Information and Library Services
LAWS OF TURBULENT MIXING OF CO-AXIAL FLOWS IN A CHANNEL OF CONSTANT CROSS-SECTION [ZAKONOMERNOSTI TURBULENTNOGO PEREMESHIVANIYA SOOSNYKH POTOKOV V KANALE S POSTOYANNYM POPERECHNYM SECHENIEM]
O. V. Yakovlevskii Jul. 1964 15 p refs Transl. into ENGLISH from Inzh. Zh. (USSR), v. 1, no. 4, 1961 p 39-50
(TIL/T-5411)

The drawbacks of the Cherkez theory are noted. The analysis of the turbulent mixing in the secondary flow is reduced to the determination of three unknowns (two velocity values and the static pressure) from three equations (one differential

equation of motion and two integral equations) describing the constant consumption and impulse of the fluid flow in the mixing chamber. Author

N64-30125 Grumman Aircraft Engineering Corp., Bethpage, N.Y.
THE CALCULATION OF NONLINEAR SUPERSONIC CONICAL FLOWS BY THE METHOD OF INTEGRAL RELATIONS
John W. Brook Jul. 1964 108 p refs
(Contract AF 33(657)-7313)
(FDL-TDR-64-7; AD-605284)

The supersonic flow over cones of arbitrary shape has been investigated by using the method of integral relations. The equations are derived for one strip using a body-oriented coordinate system. Various choices for the basic equations are discussed. The solution of the boundary value problem for a number of fundamentally different cases is discussed in detail, and various suggestions concerning improvements of the method and other related methods are made. Author

12 GEOPHYSICS

Includes auroral phenomena; upper atmosphere studies; oceanography; cartography; geodesy; and geomagnetism. *For Van Allen belts see*: 28 Space Radiation. *For related information see*: 05 Astronomy and Astrophysics; 21 Meteorology; and 29 Space Sciences.

N64-29058 Israel Program for Scientific Translations, Ltd., Jerusalem
THE DETERMINATION OF ELECTRON DENSITY IN THE OUTER REGIONS OF THE IONOSPHERE FROM OBSERVATIONS OF RADIO SIGNALS RECEIVED FROM THE FIRST ARTIFICIAL EARTH SATELLITE [O NEKOTORYKH REZUL'TATAKH OPREDELENIYA ELEKTRONNOI KONTSENTRATSII VNESHNEI OBLASTI IONOSFERY PO NABLYUDENIYAM ZA RADIOSIGNALAMI PERVOGO SPUTNIKA ZEMLI]
Ya. L. Al'pert, F. F. Dobryakova, E. F. Chudesenko, and B. S. Shapiro *In its* Advan. in Phys. Sci., v. 65, nos. 1–4, May–Aug. 1958 1964 p 150–163 refs (See N64-29052 21-23) OTS: $5.75

A method of obtaining information on the properties of the ionosphere by analyzing the radio observations from satellites is presented. The method is based on timing the satellite's "radio-rising" and "radio-setting," and can be used to determine the electron density distribution in regions above the ionospheric maximum. Preliminary results obtained by processing the observed data are presented. P.V.E.

N64-29070 Israel Program for Scientific Translations, Ltd., Jerusalem
HYDROGEN EMISSION IN AURORAL SPECTRA [VODORODNAYA EMISSIYA V SPEKTRAKH POLYARNYKH SIYANII]
B. A. Bagaryatskii *In its* Advan. in Phys. Sci., v. 65, nos. 1–4 May–Aug. 1958 1964 p 453–485 refs (See N64-29052 21-23) OTS: $5.75

A survey of literature dealing with the interaction of the solar corpuscular stream with the atmosphere is presented. The survey is divided into two parts—experimental data on hydrogen emission in aurora polaris and theories of hydrogen emission in aurora polaris. P.V.E.

N64-29079 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE AURORAS POLARIS AND NIGHT SKY RADIATION
V. I. Krasovskiy *In its* Cosmic Res., v. 2, no. 2 8 Jun. 1964 p 61–86 refs (See N64-29076 21-01)

Various explanations of the aurora polaris and night sky radiation are reviewed. Among these are the proposal that the corpuscles that cause aurora polaris are not primary solar corpuscles, but corpuscles that arise in the earth's atmosphere as a result of complicated processes of interaction with corpuscular streams from the sun. A phenomenon for explaining night radiation is as follows: The flow observed at night is due to streams or atmospheric flows in a dissociated region with a very rich content of effectively exciting molecules. In addition, characteristics of these auroras, such as radiation belts, etc., and the effects of auroras on the earth's atmosphere are discussed. I.v.L.

N64-29083 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE DISCOVERY IN THE UPPER ATMOSPHERE OF ELECTRONS WITH ENERGIES FROM 40 ev TO 5 kev
T. M. Mulyarchik *In its* Cosmic Res., v. 2, no. 2 8 Jun. 1964 p 148–156 refs (See N64-29076 21-01)

By means of fluorescent screen indicators on board Cosmos IV, electrons were recorded that had an energy of 0.04 to 4 kev. Their maximum intensity reaches $5 \cdot 10^9$ electrons $-cm^2/sec/sterad$ (under isotropic distribution conditions and if E = 1 Kev), the average intensity was $5 \cdot 10^8$ electrons/cm/sec/sterad, and the sensitivity threshold of the apparatus was $2 \cdot 10^7$ electrons/cm/sec/sterad. There is a tendency for the intensity to increase as height increases. These electrons are recorded primarily during the daytime; they disappear several minutes after the satellite enters the earth's shadow and reappear again several minutes after it comes out of the shadow. Author

N64-29085 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
EXPERIMENTAL INVESTIGATION OF THE CONSTANTS OF IONOSPHERIC ION EXCHANGE PROCESSES
A. D. Danilov and C. P. Yatsenko *In its* Cosmic Res., v. 2, no. 2 8 Jun. 1964 p 163–169 refs (See N64-29076 21-01)

A description is given of the first experiment in the rate of basic ion exchange in the ionosphere by means of an "air-discharge" device and a radiofrequency mass spectrometer, both of which were installed on a geophysical rocket. As a result of the experiment it was possible to record artificially formed ions of O_2^+. This made it possible to estimate the relative magnitudes of the rate constants for the basic ionospheric ion exchange processes $\gamma_1/\gamma_2 \leq 0.1$ and $\gamma_3/\gamma_2 \leq 1$. An estimate of the value γ_1/γ_2 made it possible to select the most reliable laboratory values for the constants γ_1 and γ_2. Author

N64-29099 St. Louis U., Mo. Inst. of Technology
SOME EFFECTS OF A LAYERED SYSTEM ON DILATATIONAL WAVES
Willard J. Hannon 31 Jul. 1964 74 p refs
(Contract AF 19(604)-7399; ARPA Order-292, Amend. 7; Proj. Vela-Uniform)
(TR-3; AFCRL-64-614; AD-444911)

The effect of crustal model on the variation of surface motion with angle-of-incidence is examined by an application of the matrix formulation of N. A. Haskell. Six crustal models, including such features as low velocity surface layers, low

velocity layers at depth, and relatively thick and thin total thickness, are examined. Transmission coefficients are computed for frequencies ranging from 0.02 cps to 10.0 cps, and for angle-of-incidence ranging from 21° to 53°. The surface motion due to an incident wave of the form $(1/\pi)$ (sin $20\pi t)/t$ is computed. Author

N64-29197* Illinois U., Urbana Coordinated Science Lab.
THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF ELECTRON DENSITY AND COLLISION FREQUENCY IN THE LOWER (D AND E) REGIONS OF THE IONOSPHERE BY RESEARCH ROCKET RADIO TRANSMISSIONS DURING THE IQSY USING DIFFERENTIAL ABSORPTION, FARADAY ROTATION AND MASS SPECTROMETRY
D. Skaperdas and H. Knoebel 10 Jun. 1964 21 p
(Grant NsG-504)
(NASA-CR-56939; SASR-2) OTS: $2.60 ph

A rocket was fired as part of a series of experiments conducted under a synoptic IQSY program. The experiment, which was very successful, utilized a Nike-Apache rocket and part of its 60-pound payload, which was sent 105 miles into the atmosphere. The purpose of this experiment was to measure the differential absorption and Faraday rotation for the determination of electron collision frequency in the D-region. This report describes the system used to make these measurements and presents the data obtained from them. Author

N64-29199* High Altitude Observatory, Boulder, Colo.
THE ZODIACAL LIGHT AT 5300 A
J. L. Weinberg Jul. 1964 53 p refs
(Grant NsG-135)
(NASA-CR-58496) OTS: $5.60 ph

The surface brightness, the degree, and the orientation of the plane of polarization of the zodiacal light at 5,300A are reviewed. A comparison of the author's observations in the plane of the ecliptic with calculations of the brightness and polarization of radiation scattered by single component and metallic, and dielectric particles and electrons) according to Giese and Seidentopf, 1962, and Giese, 1963, led to the following conclusions: (1) Dielectric particles can account for the major fraction of both brightness and polarization of the zodiacal light that is observed. (2) The 5μ (radius) is either an approximate upper limit to the particle-size distribution, or the size distribution has a steep slope such that there are few large particles. (3) Metallic particles are not present in large numbers. (4) A steady-state distribution of free electrons in interplanetary space, provided such a distribution really exists, cannot have a density greater than some tens of electrons per cm^{-3}. Observations at high ecliptic latitudes clearly indicate that the zodiacal light covers the entire sky and that brightness and polarization undergo changes. I.v.L.

N64-29245 Raytheon Co., Norwood, Mass.
INVESTIGATIONS OF ELECTRICAL CHARACTERISTICS OF ROCK MEDIUM IN NORTHERN NEW YORK STATE Scientific Report No. 3
Carson K. H. Tsao Jan. 1964 56 p refs
(Contract AF 19(628)-2362)
(AFCRL-64-99; AD-600758)

Measurements have been made in drill holes located in several areas in northeastern New York State to determine the conductivity of the rock media surrounding the drill holes. Conductivities in the drill holes were deduced from the quarter-wave resonance frequencies of insulated monopole antennas. Conductivity profiles in the holes were obtained from the input conductances of electrically short bare dipoles. Author

N64-29282* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
REPLY [TO SUN'S ARTICLE ON TEKTITES]
Dean R. Chapman Repr. from J. of Geophys. Res., v. 69, no. 9 1 May 1964 2 p refs
(NASA-RP-235)

In this report, the author replies to Sun's comments that question the following: (1) the theory of the lunar origin of tektites; (2) the suggestion that they might have come from the large lunar crater Tycho (Chapman, 1963); and (3) the reliability of the particular atmosphere-entry trajectories deduced from the aerodynamic analysis in papers by Chapman, 1963, and Gault and Heitowit, 1963. I.v.L.

N64-29301 Oslo U., Blindern (Norway) Inst. of Theoretical Astrophysics
INTERFEROMETRIC MEASUREMENTS OF THE 5200/02 A [NI]-DOUBLET IN THE AURORA Scientific Report No. 1 Report No.
S. H. H. Larsen 1964 7 p refs Repr. from Planet. Space Sci., v. 9, 1962 p 811–813
(Contracts AF 61(052)-252; AF 61(052)-680)
(AFCRL-64-624; AD-444672)

Because of the low intensity of the aurora, conventional spectrographs with the necessary light power will have a low dispersion and the spectra obtained do not allow separation of the two lines in the 5200/02 A [NI]-doublet. An interferometer was therefore used in an attempt to separate the lines, measure their wavelengths with great accuracy, and estimate the intensity ratio between the two lines. Three Fabry–Perot etalons of quartz with semitransparent silvercoating and with thicknesses 5·0, 2·5, and 1·5 mm were available. For the 5·0 and 2·5 mm etalons the two sets of fringes happened to overlap. Because of this, only the 1·5 mm etalon could be used. Pictures and a photometric record of the fringes of the auroral [NI]-doublet are presented. Author

N64-29306 Naval Ordnance Test Station, China Lake, Calif. Test Dept.
DIOPTRIC TABLES OF THE EARTH'S ATMOSPHERE; AND, EXTENSION OF THE DIOPTRIC TABLES OF THE EARTH'S ATMOSPHERE
Frantisek Link and Zdenek Sekera Jun. 1964 44 p refs Transl. into ENGLISH from Publ. of the Prague Natl. Obs. (Prague), no. 14, 1940; no. 18, 1947
(NAVWEPS-8504; NOTS-TP-3483; AD-444993)

CONTENTS:

1. DIOPTRIC TABLES OF THE EARTH'S ATMOSPHERE F. Link and Z. Sekera p 2–28 refs
2. EXTENSION OF THE DIOPTRIC TABLES OF THE EARTH'S ATMOSPHERE F. Link p 29–43 ref

N64-29315 Stanford Research Inst., Menlo Park, Calif.
IONIZATION AND DE-IONIZATION IN THE LOWER IONOSPHERE Final Report
I. G. Poppoff and R. C. Whitten 31 Mar. 1963 116 p refs
(Contract AF 19(604)-8355; ARPA Order-6-61)
(AD-418467)

A body of information pertaining to ionization and deionization in the lower ionosphere was compiled from various sources. Part of the data was derived from studies of geophysical observations, part of it from published and unpublished laboratory measurements, and part from other ionospheric studies. Models of lower ionospheric processes were prepared that are consistent with presently available data from these sources. Conclusions were drawn pertaining to the following: (1) ionization processes—solar flare-induced ionization, ionization by background solar X-rays, and ionization by auroral electrons; and (2) deionization processes—negative ions, charge transfer and ion-atom interchange, dissociative recombination, ion-ion recombination, and diffusion to dust. I.v.L.

N64-29342* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

PHOTOGRAPHIC OBSERVATIONS OF THE AIRGLOW LAYER

F. C. Gillett, W. F. Huch, E. P. Ney(Minnesota U.), and Gordon Cooper Repr. from J. Geophys. Res., v. 69, no. 13, 1 Jul. 1964 p 2827–2834 refs

The night airglow photographs taken by Gordon Cooper during his orbital flight of May 15 and 16, 1963, are discussed. They show an airglow layer 24 ±3 km thick and varying in height above the earth from 77 to 110 km. The measured brightness indicates a surface brightness in a vertical column through the airglow layer 0.4 Rayleigh/A in the vicinity of 5,400 A and 0.6 Rayleigh/A at 4,200 A. Author

N64-29343* Southwest Center for Advanced Studies, Dallas, Tex.

VARIATION OF THE GEOMAGNETIC FIELD WITH SOLAR ACTIVITY AT TUCSON

S. S. Degaonkar Repr. from J. Geophys. Res., v. 68, no. 22, 15 Nov. 1963 p 6206–6207 refs
(Grant NsG-269-62)

Analyses are reported of annual means of magnetic field data for international quiet days at 3 American stations—Fredericksburg, Tucson, and Honolulu. The secular variation in the horizontal, vertical, and total field was eliminated by taking the 11-year moving average in each case and subtracting that from its corresponding annual mean. Thus ΔH, ΔZ, and ΔF were obtained and were plotted against the year in each case for these stations. Author

N64-29386* State U. of Iowa, Iowa City

LARGE DIURNAL VARIATIONS OF GEOMAGNETICALLY TRAPPED AND OF PRECIPITATED ELECTRONS OBSERVED AT LOW ALTITUDES

J. A. Frank, J. A. Van Allen, and J. D. Craven Repr. from J. Geophys. Res., v. 69, no. 15, 1 Aug. 1964 p 3155–3167
(Grant NsG-233)

The diurnal variation of the intensities of geomagnetically trapped electrons and that of precipitated electrons is observed to be similar in data obtained with low-altitude satellite Injun III over the period December 1962 to September 1963. The northern limit of detectable electron ($E \geq 40$ Kev) intensities was at $L \simeq 20$ ($\Lambda \simeq 77°$) at local noon and at $L \simeq 8$ ($\Lambda \simeq 69°$) at local midnight. Several polar plots of the median intensities of electrons as a function of local time and the shell parameter L(and Λ = arc cos $L^{-1/2}$) are displayed. A local acceleration mechanism for electrons ($E \geq 40$ Kev) on the sunward side of the magnetosphere is suggested in this preliminary study by an apparent maximum of precipitated electron intensities near local noon at $L \sim 8$. The diurnal effect (a factor of the order of 100 or greater) begins abruptly at $L \sim 8$ and extends to all higher L shells; the local time dependence of the median electron intensities is more or less symmetrical about the noon-midnight meridian, but may be more nearly symmetrical about a meridian of ~1,100 (±2 hours) beyond $L \sim 10$. Author

N64-29400* California U., Los Angeles Inst. of Geophysics and Planetary Physics

[CHARGED PARTICLE RESEARCH AND MAGNETIC RESEARCH] Semiannual Report, Jan. 1–Jun. 30, 1964

Paul J. Coleman, Jr. and Thomas A. Farley [1964] 17 p refs
(Grant NsG-249-62)
(NASA-CR-58669) OTS: $1.60 ph

Work on space-instrument development has concentrated on charged-particles and magnetic-fields research. The charged-particle research program, which involves both trapped Van Allen radiation and interplanetary cosmic rays, includes these: (1) electron detectors for EGO-3; (2) an experiment to determine the isotopic abundance, flux, and energy spectra of the hydrogen and helium isotopes in solar and galactic cosmic rays; (3) a program to compute pitch-angle distribution from omnidirectional intensities; and (4) calibration of space-radiation monitoring instruments for the Department of Defense. The magnetic fields research program includes these: (1) reduction and analysis of data from the Mariner II magnetometer; (2) studies of related measurements; (3) preparations for Mariner-C magnetometer experiment; and (4) development of new instruments to study hydromagnetic disturbances and their effects on geomagnetically trapped particles. M.P.G.

N64-29517* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

MEAN DIURNAL VARIATION OF THE TOPSIDE IONOSPHERE AT MID-LATITUDES

S. J. Bauer and L. J. Blumle Apr. 1964 21 p refs
(NASA-TM-X-55042; X-615-64-99) OTS: $2.60 ph

About 500 ionograms obtained with the Alouette satellite have been used to construct the mean diurnal variation of the midlatitude topside ionosphere. Since this diurnal variation is based on observations from October to December 1962, quasi-seasonal effects had to be removed. The data are presented in form of electron density contours at fixed altitudes for two latitude ranges, 35° N to 40° N and 40° N to 45° N. These two latitude ranges, which are approximately separated at the 75° W meridian by the 70° magnetic dip line, show remarkable differences in the detailed behavior of electron density as a function of time and altitude. From the scale heights of these mean distributions, it is apparent that there is absence of thermal equilibrium, at least during the day, and that light ionic constituents become important in the altitude region from 500 km to 1000 km, especially during the night. Author

N64-29540 Joint Publications Research Service, Washington, D.C.

USING ARTIFICIAL SATELLITES FOR MEASUREMENT OF IONOSPHERIC ELECTRON CONCENTRATION

E. Ye. Mityakova 10 Sep. 1964 11 p refs Transl. into ENGLISH from Geomagnetism i Aeronomiya (Moscow), v. 4, no. 4, Jul.–Aug. 1964 p 668–674
(JPRS-26345; TT-64-41604) OTS: $1.00

A method is discussed for processing the records of Faraday fadings of artificial earth satellite signals, for determining the quantity of electrons in a vertical column of a unit cross section. The article contains the derivation of computation formulas, and indicates the limits of their applicability. Results

are given of processing of the amplitude records of the artificial earth satellites Cosmos I and Cosmos II in the Crimea in March–April 1962, and the satellite Explorer-VII at Gor'kiy early in 1962. Author

N64-29547* Woods Hole Oceanographic Institution, Mass.
THE SURFACE TEMPERATURE OF A TROPICAL ISLAND
Margaret Chaffee Feb. 1964 52 p refs Prepared Jointly with Calif. U. *Its* Reference 64-7
(Grants NsG-481-63; NSF-GP-1158)
(NASA-CR-58529) OTS: $5.60 ph

A Richardson radiometer mounted in a C-54 aircraft was used to measure the apparent surface temperature of the island of Barbados, West Indies. Runs across the island at 1,000-ft elevation were made on 5 days, under synoptic conditions that varied from suppressed to strongly disturbed. Author

N64-29723 Rostock U. (E. Germany)
INVESTIGATIONS OF THE OUTER IONOSPHERE AND ITS NORMAL VARIATIONS [UNTERSUCHUNGEN UBER DIE AUSSERE IONOSPHARE UND DEREN REGELMASSIGE VARIATIONEN]
K. H. Schmelovsky E. Berlin, Akad.-Verlag, 1962 86 p refs In GERMAN; ENGLISH summary *In* Abhandl. Meteorol. Hydrol. Dienstes DDR (E. Berlin) v. IX, no. 68 Available from Akad.-Verlag GmbH, Leipziger Str. 3–4, Berlin W 8 (E. Germany): DM 24,50

The methods used for investigating the outer ionosphere, especially the Faraday fading of satellite signals, are described. Results demonstrate that the scale height of the ionized constituents shows marked seasonal variations and that the total electron number up to about 1,000 km is greater in winter (especially at noon) than in summer. Using these results and after some further investigations about the structure of the whistler region, a theoretical model describing the mean structure of the outer ionosphere and a hypothesis to explain the summer–winter anomaly of f_0F_2 are found. Author

N64-29827 General Electric Co., Syracuse, N.Y. Heavy Military Electronics Dept.
DISPERSIVE CHARACTERISTICS OF THE IONOSPHERE Interim Report No. 1
Griffiss AFB, N.Y., RADC, Jun. 1964 54 p refs
(Contract AF 30(602)-3360)
(RADC-TDR-64-219; AD-604122)

The investigation is divided into three categories: (1) determination of parameters of ionosphere profiles from forward oblique soundings; (2) path loss and the parameters by which it is affected; and (3) natural disturbances, irregularities, and their influence on categories (1) and (2). This effort includes the observation, study, and analysis of actual measurements. Vertical, forward, and backscatter bidirectional soundings, together with data from a coordinated high resolution amplitude and relative time shift measuring system, are employed for use in the study. Included are the preparatory technique for extracting information on oblique ionograms, equipment preparation, calibration of systems, and the study of refraction and ground effects related to the path loss investigation. Author

N64-29836 Pennsylvania State U., University Park Ionosphere Research Lab.
THE MEASUREMENT OF PHASE AND AMPLITUDE RADIO WAVE INTERACTION AT UNIVERSITY PARK, PENNSYLVANIA, FOR JANUARY-FEBRUARY-MARCH, 1964 Scientific Report No. 207
A. J. Ferraro and H. S. Lee 1 May 1964 42 p refs
(Contract AF 19(628)-4014; Grant NSF GP-846)
(AFCRL-TN-64-451; AD-604432)

The objective of the present work is to study the properties of ionospheric D-region using radio wave interaction effect, which is also commonly known as Luxembourg effect. The present technique closely follows that developed by Fejer (1955) for radio-wave amplitude interaction experiment. However, the technique of measurement, as well as the theory of radio wave interaction, has been extended and generalized by the introduction of complex coefficient of interaction T, to embody the effect of interaction on both the amplitude and the phase of radio waves. Author

N64-29862 RAND Corp., Santa Monica, Calif.
MODAT: A COMPUTER PROGRAM FOR THE CONSTRUCTION OF MODEL ATMOSPHERES
L. C. Kern and G. F. Schilling Jul. 1964 77 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4204-PR; AD-603157)

The program is written in FORTRAN II for the IBM 7090 and is applicable to the evaluation of atmospheric conditions on any planet of the solar system. Depending on the amount of information available about a planet and its atmosphere, three different program versions of increasing complexity can be used, combined or interchanged, to provide the desired tabulation of atmospheric parameters up to altitudes of one planetary radius. The program can be called upon to print, or to provide, in the form of card decks, the basic data on atmospheric pressure, temperature, and density, as well as a series of auxiliary quantities, including scale heights, number density, mean molecular mass, columnar mass, gravitational acceleration, and potential. Primary numerical values are available both in cgs units and in engineering units at any desired altitude level. Author

N64-29866 Army Materiel Command, Hanover, N.H. Cold Regions Research and Engineering Lab.
BIBLIOGRAPHY ON SNOW, ICE, AND PERMAFROST WITH ABSTRACTS. CUMULATIVE INDEX, VOLS. I–XVII
Frank M. Marson et al Jun. 1964 260 p
(CRREL-12; AD-602778)

N64-29867 Army Materiel Command, Hanover, N.H. Cold Regions Research and Engineering Lab.
STRUCTURAL CONTROL OF THE VERTICAL VARIATION OF THE STRENGTH OF SEA AND SALT ICE
W. F. Weeks and A. Assur Apr. 1964 21 p refs
(RR-113; AD-602458)

The vertical variation in the strength of sea ice was studied by using data from NaCl ice, which shows a structural similarity to sea ice and has straightforward phase relations. Nested horizontal thin sections were prepared at seven different levels below the surface of the test NaCl ice sheet, and the plate spacing and the distance between centers of adjacent brine layers measured parallel to the *c*-crystallographic axis were determined. The measurements show that the plate spacing is a linear function of the sixth root of the distance below the upper ice surface (z). Available values of the same parameter for natural sea ice are in good agreement with this relation. Equations giving the dependence of the ring-tensile strength of the ice on *z* are developed. The specific equation depends upon which model is assumed for the variation of brine pocket dimensions with changes in the brine volume. Author

N64-29924 Columbia U., New York, N.Y.
EFFECT OF LOADING RATE ON THE DEFORMATIONAL BEHAVIOR OF ROCKS SUBJECTED TO TRIAXIAL COMPRESSION Final Report, 22 Jun. 1963–21 Jun. 1964
Fred A. Donath 31 Jul. 1964 88 p refs
(Contract DA-31-124-ARO(D)-121; Grants DA-ARO(D)-31-124-G149; DA-ARO(D)-31-124-G359)
(AROD-3055-1; AD-446650)

Effects of confining pressure, total strain, and loading rate on deformational behavior of a limestone, a marble, a shale, and a slate subjected to triaxial compression have been studied. Mode of deformation (uniform flow to ductile faulting) in the limestone and marble depends strongly on both confining pressure and total strain. Shale and slate tend to be brittle and fail by shear fracture. All showed an increase in ultimate strength, elastic modulus, and ductility with increased confining pressure. Author

N64-29992 Air Force Cambridge Research Labs., Bedford, Mass.
OZONESONDE OBSERVATIONS OVER NORTH AMERICA, VOLUME 2 Environmental Research Paper No. 38, Apr.–Aug. 1963
Wayne S. Hering and Thomas R. Borden, Jr., ed. Jul. 1964 286 p refs
(AFCRL-64-30(II); AD-604880)

A network of eleven ozonesonde stations was established in North America to provide high-resolution observations of the vertical ozone distribution for a variety of research purposes. This volume contains the ozonesonde and associated radiosonde observations for the months of April through August 1963. Also included are the average distributions of ozone over the North American continent as derived from the network observations. Data averages for overlapping bimonthly periods are presented for January–February through July–August 1963. Author

N64-29994 Air Force Cambridge Research Labs., Bedford, Mass.
GEODETIC POSITIONING FROM SIMULTANEOUS OPTICAL OBSERVATIONS OF THE ANNA I-B SATELLITE Environmental Research Paper No. 35
Lyndon L. Sheldon and Donald H. Eckhardt Jul. 1964 24 p refs
(AFCRL-64-562; AD-605274)

Simultaneous photographic observations of flashes from the ANNA I-B geodetic satellite were made by Air Force PC-1000 cameras. Geodetic position determinations using these ANNA observations indicate that the PC-1000 camera system used with the intervisible technique is capable of extending geodetic control to a proportional accuracy of better than 1/100,000. Author

N64-30004 Syracuse U. Research Inst., N.Y. Coll. of Engineering
THE USE OF FOAMED PROPELLANTS FOR COMPACTION AND STABILIZATION OF VARIOUS TYPES OF TERRAIN Final Report
Louis J. Goodman, Cornelius S. Grove, Jr., and Ardeshir Aidun Jul. 1964 63 p refs
(Contract AF 19(628)-492)
(SURI-CE-974-647FI; AFCRL-64-622; AD-604446)

A proposed new method for compacting soil, which is based on the principle of pressure waves as a source of compaction energy, is described. This method has a formulation containing hydrazine, ammonium perchlorate, and a foaming agent—hydrolized protein base foam liquid. The mechanics of this new compaction method are relatively simple, with a blanket of the foamed propellant system placed on the surface of the soil to be compacted, and then detonated. The results of using the foamed propellant system to compact both cohesionless and cohesive soils are presented and discussed. This includes a preliminary investigation of the influence of both surface area and multiple detonation on compaction control parameters. Results show that this compaction method is effective in increasing the density of the soil to depths of as much as 15 inches. Author

N64-30069 Harvard Coll. Observatory, Cambridge
GENERALIZATION AND CRITIQUE OF THE WIND-SHEAR THEORY OF SPORADIC *E*
David Layzer Repr. from J. Geophys. Res., v. 69, no. 9, 1 May 1964 p 1853–1860 refs Harvard Reprint 654

Previous discussions of the hypothesis that sporadic *E*-layers result from a redistribution of existing ionization caused by vertical ionization drift have rested on special and somewhat unrealistic assumptions. This paper formulates the hypothesis in a more general way and compares its implications with recent experimental results concerning the structure of E_s-layers and the connection between ionization profiles and wind profiles in the *E*-region. The main results of the paper are as follows: (1) Observed ionization profiles have nearly rectangular peaks of uniform width (≤ 1 km) and variable height ($1 \leq N_{max}/N_0 \leq 10^2$) superimposed on an apparently unperturbed background. (2) Theoretically, layers of enhanced ionization will form in regions where the wind shear is exceptionally high. Observation shows that the reverse is true. (3) The fractional changes that can be produced by vertical ionization drift appear to be considerably smaller than those observed to be associated with E_s layers. Author

N64-30078* National Aeronautics and Space Administration, Washington, D.C.
A DISCUSSION OF THE VARIATION WITH TIME OF THE PARAMETERS OF THE GEOMAGNETIC FIELD BASED ON THE EXISTING POTENTIAL ANALYSES [BETRACHTUNGEN UBER DIE ZEITLICHE ANDERUNG DER PARAMETER DES GEOMAGNETISCHEN FELDES AUF GRUND DER VORLIEGENDEN POTENTIALENTWICKLUNGEN]
P. Mauersberger Aug. 1963 133 p refs Transl. into ENGLISH from Abhandl. Geophys. Inst. Potsdam, (E. Berlin), no. 5, 1952 p 9–58
(NASA-TT-F-8443) OTS: $10.50 ph

Without taking into account the oblateness of the earth or separating the sources of the geomagnetic field into those lying within and without its surface, the 48 "gaussian constants," g_n^m and h_n^m of the first six orders, were obtained as functions of time from the more important geomagnetic potential analyses made between 1829 and 1945. The numerical values of the coefficients employed for this purpose were taken from the original publications and reduced to 10 γ units and Adolf Schmidt's quasi-normalized spherical harmonics, p_n^m. The change in the coefficients with time and the decrease in the "moment" were in general much greater than three times their mean errors, which stem from the adjustment made, and from the uncertainty of the "observational values" taken from charts and used in the analyses. On the basis of the reasoning of Adolf Schmidt and on the basis of the principle of the existing potential analyses, an attempt was made to estimate the order of magnitude of these errors, taking into account the figures given in the original publications (publications pertaining to the selected geomagnetic potential analyses). I.v.L

N64-30079* National Aeronautics and Space Administration, Washington, D.C.

ANALYTICAL REPRESENTATION OF THE GEOMAGNETIC FIELD AND THE SECULAR VARIATION [DIE ANALYTISCHE DARSTELLUNG DES GEOMAGNETISCHEN HAUPTFELDES UND DER SAKULARVARIATION]

Heinz Kautzleben Nov. 1963 147 p refs Transl. into ENGLISH from Abhandl. Deut. Akad. Wiss. Berlin, Geomagnetisches Inst. Potsdam (E. Berlin), no. 32 1963
(NASA-TT-F-8700) OTS: $1.10 ph

Topics discussed include representation of the vertical component on the terrestrial surface, representation of geomagnetic potential on the earth's surface, representation and analysis of total intensity and horizontal intensity, error in potential calculations, representation of the secular variation, formulas for spherical harmonics, and orthogonal polynomials for discrete distributions of value. D.E.W.

N64-30081* National Bureau of Standards, Boulder, Colo. Central Radio Propagation Lab.

SPREAD-F OBSERVATIONS BY THE ALOUETTE TOPSIDE SOUNDER SATELLITE

Wynne Calvert and Charles W. Schmid Repr. from J. Geophys. Res., v. 69, no. 9, 1 May 1964 p 1839–1852 refs Sponsored by NASA

Ionograms recorded by the Alouette topside sounder satellite exhibit a variety of spread-*F* echo configurations. The observed echoes are found to be consistent with three qualitative radio-propagation models involving aspect-sensitive scattering by thin magnetic-field-aligned irregularities, ducting along broad irregularities, and refraction within large-scale reductions of electron density. A large number of Alouette ionograms were examined for the three types of spread *F* to determine their frequency of occurrence. Spread *F* appeared on 54% of the topside ionograms; the three types exhibit markedly different patterns of occurrence in geomagnetic latitude and local time. Author

N64-30085* McGill U., Montreal (Canada)

WORLD ATLAS OF PHOTOGRAPHY FROM TIROS SATELLITES I TO IV

J. B. Bird, A. Morrison, and M. C. Chown Washington, NASA, Sep. 1964 156 p refs
(Contract NASr-140)
(NASA-CR-98) OTS: $3.00

The major part of this report is a selection of over 400 photographs taken by Tiros satellites I to IV, including one or more pictures of every state of the United States and of most other land areas of the world between 55° N and 55° S. They are identified as clearly as the data permit by distinctive and commonly recognized landmarks. A variety of surface features can be distinguished on the best of the Tiros photos of land areas, when they are not obscured by clouds. Author

N64-30091* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

VAPOR PRESSURE AND VAPOR FRACTIONATION OF TEKTITE MELTS

L. S. Walter and M. K. Carron (Geol. Surv.) Washington, NASA, Sep. 1964 17 p refs
(NASA-TN-D-1084) OTS: $0.50

The total vapor pressure of philippinite tektite melts of approximately 70% silica has been determined for temperatures ranging from 1,500° to 2,100°C. It is 190 ±40mm Hg at 1,500°C, 450 ±50mm at 1,800°C, and 850 ±70 mm at 2,100°C. The relative volatility from tektite melts of the oxides of Na, K, Fe, Al, and Si has been determined as a function of temperature, total pressure, and, roughly, oxygen fugacity. The volatility of SiO_2 is decreased and that of Na_2O and K_2O is increased in an oxygen-poor environment. Preliminary results indicate that volatilization at 2,100°C under atmospheric pressure causes little or no change in the percentage of Na_2O and K_2O. The Fe^3/Fe^2 ratio of the tektite is increased in ambient air at a pressure of 9×10^{-4} mm Hg ($10^{-6.5}$ atm O_2, partial pressure) at 2000°C. This suggests that tektites either formed at lower oxygen pressures or were a product of the incomplete oxidization of a parent material with a still lower ferric–ferrous ratio. Author

N64-30152 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

ALTITUDE DISTRIBUTION OF CHARGED PARTICLES IN IONOSPHERE AND TRANSITIONAL REGION BETWEEN OXYGEN AND HELIUM IONIC LAYERS BY DATA FROM EXPERIMENTS WITH ION TRAPS ON SATELLITE "KOSMOS-2"

K. I. Gringauz, B. N. Gorozhankin, N. M. Shyutte, and G. L. Gdalevich 7 Jun. 1964 11 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 151, no. 3, 1963 p 560–563
(FTD-MT-64-53; AD-603323)

Experiments conducted with ion traps on cosmos-2 attest that previous observations of charged particles in the ionosphere and between oxygen and helium ionic layers have been correct. However, peculiarities that were noted of the external ionosphere are inherent only in the period closest to the maximum of solar activity, and change with time. A.W.

N64-30166 Midwest Research Inst., Kansas City, Mo.

INVESTIGATION OF TERRAIN ROUGHNESS Final Report

Carlo J. Roma Ft. Eustis, Va., Army Transportation Res. Command, May 1964 35 p
(Contract DA-44-177-TC-846)
(TRECOM-TR-64-19; AD-603518)

Field operational capabilities were provided for in a modification of the existing terrain profilometer system. These capabilities were then tested in a series of surveys run in the vicinity of the Yuma Proving Ground. A computer program was developed and used to reduce the terrain data to a continuous profile. A postoperational modification was made following the survey work to improve the system accuracy and efficiency. Author

N64-30173 Texas Instruments, Inc., Dallas

WORLDWIDE COLLECTION AND EVALUATION OF EARTHQUAKE DATA Final Report on Evaluation of 1960 Seismicity

R. L. Fisher, R. G. Baker, and R. R. Guidroz Bedford, Mass., AFCRL, Jun. 1964 204 p refs *Its* Special Repts. no. 3
(Contract AF 19(604)-8571; Proj. Vela Uniform)
(AFCRL-64-520; AD-605272)

Emphasis was placed on earthquakes in the magnitude range 5.0 to 6.0 (Richter scale). Also many shocks of magnitude 3.0 to 5.0 were recorded, and results are given for these events. Magnitude calculations for as many events as possible allow energy classification of nearly all earthquakes listed in the bulletins of the Bureau Central International de Seismologie for 1960. The publication of these magnitude data allows better assessment of the earth's seismicity and also

enables seismologists to evaluate, quantitatively, the capabilities of the seismograph station that recorded these quakes. Seismicity is defined by the temporal, spatial, and energy variations of seismic activity. Origin times, epicenters, and depths of foci are used to describe the temporal and spatial characteristics. Energy classification is usually accomplished by assigning magnitudes to earthquakes. I.v.L.

N64-30188 Texas U., Austin Electrical Engineering Research Lab.
A STUDY OF THE TRANSMISSION OF PLANE HYDROMAGNETIC WAVES THROUGH THE UPPER ATMOSPHERE
C. E. Prince, Jr., F. X. Bostick, Jr., and H. W. Smith 15 Jul. 1964 244 p refs
(Contract Nonr-375(14))
(Rept.-134; AD-443875)

A new conductivity dyadic was used to study the propagation of ordinary and extraordinary modes of wave propagation in a partially ionized gas. The conductivity tensor included effects of all collisions and the motion of neutral particles. Medium parameters were those of the earth's upper atmosphere. The range of frequencies considered was that of geomagnetic micropulsations, 0.001 to 10.0 cps. Author

13 HEAT TRANSFER AND THERMODYNAMICS

Includes ablation; cooling; heating; and other thermal effects. *For aerothermodynamics see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 03 Aerodynamics of Wings, Rotors, and Control Surfaces. *For combustion see*: 26 Propellants and Combustion. *For related information see*: 11 Fluid Mechanics.

N64-29246 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
APPLIED THERMODYNAMICS AND HEAT TRANSFER
I. I. Novikov and K. D. Voskresenskiy 21 Jun. 1963 676 p refs Transl. into ENGLISH of the book "Osnovy Yadernoy Energetiki" Moscow, Gos. Izd. Lit. V Obl. At. Nauki i Tekhn., 1961 p 1–548
(FTD-TT-63-17/1+2; AD-417207)

This book contains basic information on thermodynamics and heat transfer. It considers the large relative significance of problems involved in the removal of heat from nuclear reactors and the conversion of this heat into other forms of energy. I.v.L.

N64-29283* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
DIFFUSION APPROXIMATION FOR THERMAL RADIATION IN GASES WITH JUMP BOUNDARY CONDITION
R. G. Deissler Repr. from J. Heat Transfer, May 1964 p 240–246 refs Presented at the ASME-AIChE Heat Transfer Conf. and Exhibit, Boston, 11–14 Aug. 1963
(NASA-RP-282; ASME Paper-63-HT-13)

Generalized equations are obtained for the radiative diffusion in a nongray gas and for the energy jump at a wall. By using the second-order energy jump at a wall, the diffusion approximation for radiation in a gas is improved considerably, the range of validity of the approximation being extended to lower values of optical thickness. Author

N64-29289 Oslo U., Blindern (Norway) Inst. of Theoretical Astrophysics
TRUE, ORDINARY AND EFFECTIVE THERMAL CONDUCTIVITY TENSORS FOR A LORENTZ-TYPE HYDROGEN GAS Scientific Report No. 18(40)
Arne A. Wyller 1964 27 p refs *Its* Astrophys. Norvegica, v. VIII, no. 3
(Contract AF 61(052)-186)
(AFCRL-64-615; AD-444685)

The variations of the magnetic tensor components as functions of electron gyrofrequency s and mean electron–proton collision frequency ν_m in all cases indicate, for $s \geq \nu_m$, order-of-magnitude differences from the results obtained on assuming a constant collision frequency. The introduction of the true inverse third-power velocity dependence for the collision frequency leads to the conclusion that the magnetic field is a considerably more efficient inhibitor of thermal flow than previously anticipated on the basis of Spitzer's zero approximation (ν = const.). It is tentatively indicated that the above conclusion is not altered by order-of-magnitude effects when electron–electron and proton–proton collisions are included. Author

N64-29296 Naval Ordnance Lab., White Oak, Md.
HIGH TEMPERATURE TURBULENT HEAT-TRANSFER MEASUREMENTS Ballistics Research Report 124
Barry J. Noonan and James L. Rand 20 Jan. 1964 31 p refs
(NOLTR-63-276; AD-445121)

Turbulent heat-transfer rates through a highly cooled boundary layer have been investigated experimentally by testing in the throat region of a reflected shock tunnel. Local heat-transfer measurements were made in a constant diameter pipe, simulating a flat plate, with extreme free-stream conditions. Heat-transfer rates in the neighborhood of 50,000 Btu/ft^2 sec were measured by means of a ring-type calorimeter heat-transfer gage. Author

N64-29381 Hercules Powder Co., Cumberland, Md. Allegany Ballistics Lab.
HEAT TRANSFER IN NOZZLE SYSTEMS Technical Summary Report, Feb. 17–May 16, 1964
L. Desmon, G. T. Y. Chao, and D. J. Sine Jun. 1964 43 p refs
(Contract NOw-64-0366-d)
(ABL/ARPA/QTSR-7; AD-444816)

The objectives of this program are to investigate the interrelationship of nozzle heat transfer with rocket motor operating parameters, nozzle designs, and propellant properties, and to correlate and present the results in such a way as to make them generally useful to the rocket industry. Computation and plotting of data for "Cylheat", a closed-form analytical solution for determining transient body temperatures in hollow cylinders (nozzle inserts), has been completed. Preliminary results for experimental heat-transfer test THC-4, which used an instrumented molybdenum nozzle and aluminized propellant, are given. The instrumentation and background for test CRM-1, which used direct-measuring-type radiation calorimeters in the rocket chamber, is discussed. Author

N64-29423 Canadian Armament Research and Development Establishment, Valcartier
TEMPERATURE MEASUREMENTS OF THE NEAR WAKE GENERATED BY HYPERVELOCITY BODIES
G. Gallagher and A. Lemay Jul. 1964 27 p refs
(ARPA Order 133)
(CARDE-TR-502/64)

The wake radiation associated with hypervelocity ablating (lexan) 1-in.-diam spheres fired from light gas guns into a pressurized range facility was found to be gray body within detectable limits. A two-wavelength temperature method was then used to measure the color temperature of the radiation of the wake from immediately behind the body, through the recompression zone to approximately seven body diameters. The temperature results and the emissivity values are given for initial range pressures varying from 30 to 150 mm for sphere velocities of approximately 15,000 fps. Author

N64-29443 ARO, Inc., Arnold Air Force Station, Tenn.
INTERPOLATIONS OF IMPERFECT AIR THERMODYNAMIC DATA. II: AT CONSTANT PRESSURE
C. A. Neel and Clark H. Lewis Arnold Eng. Develop. Center, Sep. 1964 223 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-64-184; AD-446386)

The recent thermodynamic air data of Hilsenrath and Klein and the previous low temperature data of Humphrey and Neel have been interpolated at constant pressure over the ranges T = 100(100) 15,000° K and log p = −6.4(0.1)4.0. Author

N64-29451* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HEAT-TRANSFER MEASUREMENTS ON A FLAT PLATE AND ATTACHED PROTUBERANCES IN A TURBULENT BOUNDARY LAYER AT MACH NUMBERS OF 2.65, 3.51, AND 4.44
Robert L. Stallings, Jr. and Ida K. Collins Washington, NASA, Sep. 1964 238 p refs
(NASA-TN-D-2428) OTS: $3.50

The more streamlined protuberances, as compared with bluff protuberances, resulted in a smaller flat-plate surface area affected by flow separation and, in general, resulted in lower heating rates both on the flat plate and on the protuberance models. Increasing the angle-of-attack of the specific protuberance model on the flat-plate surface resulted in increased heating rates both on the windward side of the model and on the flat plate windward of the model and in decreased heating rates on the leeward side of the model. Increasing Mach number resulted in increasing the heating ratio—the ratio of the local measured heating rate to the local undisturbed-plate heating rate—on both the models and flat plate, the increase being more significant on the model at the smaller boundary-layer thickness. The effect of Reynolds number on the heating ratio was, in general, very small and within data accuracy. Decreasing boundary-layer thickness resulted in increasing the heating ratio both on the model and in the flat-plate interference region and also amplified the effect of Mach number. Author

N64-29513* General Electric Co., Philadelphia, Pa. Valley Forge Space Technology Center
STUDY OF INTERFACE THERMAL CONTACT CONDUCTANCE Summary Report
Erwin Fried 1 May 1964 65 p refs
(Contract NAS8-5207)
(NASA-CR-58705; Rept.-64SD652) OTS: $6.60 ph

This report presents the results of a predominantly experimental and concurrent analytical study of the interface thermal-contact conductance between metals in a vacuum. The general problem of conductance is discussed, drawing on existing work in vacuum and in the presence of gases. The results of a literature survey are presented, and various prediction methods are discussed. A proposed approach to thermal conductance prediction is described, and the concurrent experimental program and its results are presented in detail. A number of conclusions and recommendations for future work are outlined. The method of conductance, with which this report is concerned, can be applied to space-vehicle environmental-control subsystems, space-vehicle energy-conversion devices, space environmental-simulation chambers, and research where the absence of an interstitial conducting fluid permits observation of the solid conduction mode without extraneous effects. I.v.L.

N64-29542 Du Pont de Nemours (E.I.) and Co., Aiken, S.C. Savannah River Lab.
THERMAL FATIGUE TESTS. MATERIALS OF CONSTRUCTION FOR DENITRATOR POTS
Louis P. Costas Jul. 1964 26 p refs
(Contract AT(07-2)-1)
(DP-901) OTS: $0.50

Stainless steel denitrator pots have deformed and cracked by thermal fatigue. Subsequent examination of the microstructure of type 347 stainless steel used in these vessels revealed the presence of sigma phase and led to speculation that sigma phase may play a role in embrittling the steel. Thermal fatigue tests carried out on 304L, 316, and 347 stainless steels showed that of the three, type 347 was superior and that sigma phase was not a factor in failure. Tests made with copper, clad on both sides with stainless steel, indicated that the composite material would prevent thermal fatigue by eliminating the large temperature gradients that lead to deformation and subsequent failure. Author

N64-29551* Little (Arthur D.) Inc., Cambridge, Mass.
THE METHOD OF ZONES FOR THE CALCULATION OF TEMPERATURE DISTRIBUTION Report No. 1
Peter F. Strong and Alfred G. Emslie Jul. 1963 51 p refs
(Contract NAS7-100)
(NASA-CR-56800; C-65670) OTS: $5.60 ph

The method of zones is an improved method for obtaining approximate solutions to certain partial differential equations. Its application to heat-transfer problems is discussed in detail. Checking procedures, based on the principles of reciprocity and the conservation of energy, are introduced. The method of zones is not restricted to problems in heat flow alone, but could be used in obtaining approximate solutions to many other partial differential equations, such as the biharmonic equation of the theory of elasticity. A.W.

N64-29586 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
AERODYNAMIC HEATING
V. Votyakov and V. Shumyatskiy 19 Jun. 1963 6 p Transl. into ENGLISH from Sov. Aviatsiya (Moscow), 14 Apr. 1959 p 2
(FTD-TT-63-390/1+2; AD-412890)

A general review is presented of the factors involved in aerodynamic heating and heat transfer from the skin of rockets and missiles. Included are the effect of altitude, air density, and vehicle speed; body shape; selection of heat-resistant surface materials and heat-reflecting surface finishes; the use of protective coatings and subliming materials; liquid coolant possibilities; and the installation of refrigeration systems within the vehicle. M.P.G.

N64-29596 Library of Congress, Washington, D.C. Aerospace Information Div.
A STUDY OF RESISTANCE AND HEAT-EXCHANGE IN THE MOTION OF HEATED AIR IN DIFFUSORS AND MIXERS
P. N. Romanenko, A. I. Leont'yev, and A. N. Oblivin [1964] 34 p refs Presented at the Conf. on Heat and Mass Exchange, Minsk, 1961
(AID-T-64-25; AD-601244)

Experimental studies were made of resistance and heat-exchange in a turbulent stream of heated air in an axisymmetric diffusor with 8° 4' angle of opening, and in an axisymmetric mixer with 8° angle of opening. The tests run embraced a range of numbers Re = (1,688 to 8.45) · 10^5. The temperature of the walls of the ducts, which were cooled by water, varied from 286° to 320° K; the temperature of the airstream varied from 425° to 623° K. M numbers were ≤ 0.5. Author

N64-29707* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ANALYSIS OF THE EFFECTS OF ENVIRONMENTAL CONDITIONS ON THE PERFORMANCE OF CHARRING ABLATORS
Robert T. Swann, Marvin B. Dow, and Stephen S. Tompkins [1964] 23 p refs Presented at the AIAA Entry Technol. Conf., Williamsburg and Hampton, Va., 12–14 Oct. 1964
(NASA-TM-X-51959) OTS: $2.60 ph

The performance of charring ablators is examined over a range of environmental conditions characteristic of those that might be obtained in ground-test facilities. Effects of certain environmental parameters on performance are presented. Differing effects of material characteristics on performance under various environmental conditions are discussed. Particular emphasis is placed on identification of low-enthalpy conditions, which produce the same results as high-enthalpy environments. The feasibility of testing large-scale configurations to determine their thermostructural behavior during reentry is discussed.
Author

N64-29752 Arde-Portland, Inc., Paramus, N.J.
COOLED SOLID PROPELLANT ROCKET NOZZLES, VOLUME I Final Report
Sidney Elkind 15 Jun. 1964 83 p
(Contract DA-30-069-ORD-3099)
(A-P-FR-5601; AD-602805) OTS: $4.00

A study was made to evaluate the potential of the liquid metal lithium as a coolant for solid-propellant rocket nozzles. The program plan included the analysis, design, and testing of two cooling systems—convection, and spray film. A literature survey was made to review the state-of-the-art of rocket nozzle cooling. Author

N64-29877 Naval Weapons Lab., Dahlgren, Va. Warhead and Terminal Ballistics Lab.
A HEAT TRANSFER MODEL STUDY OF THE HOT WIRE INITIATOR
J. M. Massey, Jr. 6 Jul. 1964 41 p refs
(NWL-1919; AD-602664)

A mathematical heat-transfer model, applicable to determining the sensitivity to input current of a hot-wire initiator, is developed. Simplifying assumptions are introduced that make the model amenable to solution with the use of a medium-size analog computer. The model is applied to the MARK 45 MOD 0 impulse cartridge. Solutions are compared to empirical sensitivity data for this cartridge conditioned at −80°, 68°, and 225° F. Author

N64-29894 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THERMODYNAMIC FUNCTIONS OF HAFNIUM HALIDES
A. M. Aleksandrovskaya, I. I. Godnev, and A. S. Sverdlin 9 Jul. 1964 6 p Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Khim. i Khim. Tekhnol. (Moscow), v. 6, no. 1, 1963 p 165–166
(FTD-TT-64-457/1; AD-603662)

The thermodynamic functions of HfI_4, $HfCl_4$, and $HfBr_4$ were computed and are presented in tabular form. I.v.L.

N64-29895 Hercules Powder Co., Cumberland, Md. Allegany Ballistics Lab.
"CYLHEAT" HANDBOOK. VOLUME I: TRANSIENT BODY TEMPERATURE RESPONSE CURVES FOR HOLLOW CYLINDERS WITH HEATED INTERIOR AND INSULATED EXTERIOR
Leland G. Desmon and Glen B. Avis Jul. 1964 89 p refs
(Contract NOw-64-0366-d)
(ABL/X-123; AD-446659)

This handbook of graphs portrays transient body temperatures in hollow cylinders (nozzle inserts) with heated interior and insulated exterior surface. The temperature response curves were obtained from a digital computer program entitled CYLHEAT, a closed-form analytical solution that assumes constant thermal properties. The range of variables encompasses heating times and thermal properties of all nozzle insert materials of current interest. Author

N64-29896 Hercules Powder Co., Cumberland, Md. Allegany Ballistics Lab.
METHODS FOR CALCULATION OF INSIDE WALL SURFACE TRANSIENT TEMPERATURES FOR SOLID PROPELLANT ROCKET NOZZLES
G. T. Y. Chao, J. A. Jacobsen, and J. T. Anderson Jul. 1964 50 p refs
(Contract NOrd-16640)
(ABL/Z-73; AD-446669)

The problem of accurately calculating the transient surface temperature in solid-propellant rocket nozzles is examined by using the flat plate model. Both the analytical and the numerical methods are shown to be valid provided a sufficient number of eigenvalues are taken for the analytical approach and optimum thickness of node adjacent to heating surface is taken in the numerical approach. In addition, proper distribution of node sizes and time increments can improve the accuracy of computation in the numerical method. Author

N64-29925 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
REPORT TO THE PLENARY SESSION OF THE CONFERENCE OF HIGHER EDUCATIONAL INSTITUTIONS ON THE SIMILARITY THEORY AND ITS APPLICATION IN HEAT ENGINEERING
S. G. Teletov 28 Jul. 1964 20 p Transl. into ENGLISH from Tr. Nosk. Inst. Inzh. Zheleznodorozhnogo Transp., v. 139, 1961 p 31–44
(RSIC-234; AD-604034)

In an analysis of the similarity theory and its application in heat engineering, the author arrived at the following conclusion. It is necessary to determine the principles of changing from complicated forms of association between magnitudes, in the form of differential operators, to simple ratios that directly express the definite physical ideas on the laws of the formation of the magnitudes of a complicated physical nature from the more simple associations. It is possible to

develop a technically very simple mechanism that would make it possible to realize such a direct transition from operators to those simple associations which are stipulated by the physical nature of the process and are presented in the form of gradual complexes. The combination of manipulations, by which the substitution of operators by gradual complexes is realized, is called reduction. The method of final integral transformations contains a very deep form of the ideas of generalized analysis. The transition to representation is a high degree of a peculiar, but fine and strictly substantiated, form of an operation of reduction. I.v.L.

N64-29960 Naval Research Lab., Washington, D.C. Fuels Branch

SUPERCOOLING OF HYDRAZINE

J. T. Leonard and R. N. Hazlett 12 Aug. 1964 17 p refs
(NRL-6130; AD-605166) OTS: $0.50

The supercooling of hydrazine in thin-walled capillaries and as droplets suspended in silicone oil has been investigated by observing the freezing points of samples held in the cold stage of a microscope. A wide range in capillary diameters was employed, but a smooth correlation between capillary size and degree of supercooling was not obtained due to heterogeneous nucleation at the glass surface. Suspension of hydrazine droplets in silicone oil permitted the study of much smaller samples, while eliminating the nucleating effect of solid surfaces. Also, by this procedure, foreign nuclei present in the original sample were isolated in a certain few droplets, while the majority, having been freed of foreign nuclei, froze by homogeneous nucleation. Under these conditions, the maximum degree of supercooling of hydrazine was 120° C. Using data from these experiments together with estimated values for the heat of fusion and for the free energy of activation for self-diffusion, the solid–liquid interfacial free energy for hydrazine was calculated from the theory of homogeneous nucleation to be 39.5 ergs/cm^2. Author

N64-30073 General Electric Co., Philadelphia, Pa. Missile and Space Vehicle Dept.

DETERMINATION OF AERODYNAMIC HEATING OF HYPERSONIC GLIDER WINGS

Martin Kaplan [1960] 49 p refs
(Rept.-61SD12; AD-600625) OTS: $2.00

A simplified, approximate engineering method is developed in order to predict the surface heat transfer on a flat plate with pressure gradient, caused by nose bluntness and viscous interaction effects. This method also attempts to allow for the effect of sweep and angle-of-attack on the surface heat transfer. Good agreement is obtained when correlating the new method with a limited amount of experimental data, except at conditions where the pressure gradient approaches zero. These experimental studies are for large Mach number, low density, real gas flow. Author

N64-30074 Southwest Research Inst., San Antonio, Tex.

THE USE OF MODELS FOR THE INVESTIGATION OF FIRE SPREAD Final Report

John E. Ambrose, Lester H. Eggleston, and Calvin H. Yuill 19 Aug. 1963 58 p refs
(Contract DA-49-146-XZ-146)
(AD-416537) OTS: $5.60

The purpose of this program was to investigate the use of models for the study of fire spread and the use of modeling techniques for defining those factors that contribute to the development of mass fires. The scope of the program was later expanded to demonstrate the practicability of a new concept for the nondestructive modeling of mass fires. It is concluded that mass fires cannot be modeled with information now available. Direct experimentation on small-scale models shows promise, and their use is discussed in detail. The feasibility of an electronic fire simulator has been demonstrated and offers attractive possibilities. A study of typical conflagrations indicated a good possibility for the calibration of mass fire models using actual situations. Author

N64-30097* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

HEAT-TRANSFER MEASUREMENT FOR BINARY GAS LAMINAR BOUNDARY LAYERS WITH HIGH RATES OF INJECTION

C. C. Pappas and Arthur F. Okuno Washington, NASA, Sep. 1964 44 p refs
(NASA-TN-D-2473) OTS: $1.25

Local values of surface heat transfer, wall temperature, and recovery factor were measured on a 15° porous cone with helium, air, and Freon-12 gas injection into the airstream. With air and Freon injection, the wall temperature shows a sharp rise from the laminar value at the start of transition to a peak in the transition region, then falls to the turbulent value. The peak wall temperature for one air injection test exceeded the airstream total temperature by 30° F and the coolant temperature by 184° F. With helium injection the wall temperature changed slightly at the start of transition but did not peak in the transition region. The laminar heat-transfer coefficients with air injection agree with other experiments and with theory. With Freon injection, the heat-transfer coefficients decrease with increasing injection rate more rapidly than predicted. The values go to zero at finite injection rates and remain near zero at higher injection rates. For helium gas injection, the Stanton numbers initially increase to 1.19 times the zero injection value and then fall off with increased injection to approach the theoretical value. Author

N64-30098* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EXPERIMENTAL RESULTS OF COOLING A 12.5° SEMI-VERTEX ANGLE CONE BY EJECTION OF HYDROGEN AND HELIUM FROM ITS APEX AT MACH 7

George F. Klich and Edward W. Leyhe Washington, NASA, Sep. 1964 35 p refs
(NASA-TN-D-2478) OTS: $1.00

The addition of a coolant affected heat-transfer characteristics of the boundary layer such that local film heat-transfer coefficients with coolant flow were higher than those with no coolant flow. Large reductions in local recovery temperatures were effected by injection of relatively small quantities of the coolant gases into the boundary layer of the cone. By use of measured equilibrium wall temperatures with coolant flow and a modified correlating parameter, all data from both coolants were correlated, with the exception of cases where unstable coolant injection was noted. The correlation clearly defines the thermal protection afforded the cone by steady upstream coolant ejection for the conditions investigated. Author

N64-30142 Temple U., Philadelphia, Pa.

THE APPLICATION OF P.W. BRIDGMAN'S "NEW EMF" TO EXPLODING WIRE PHENOMENA

Kenneth G. Moses and Theodore Korneff [1963] 13 p refs
(Contract AF 19(628)-215)
(AD-602913)

P. W. Bridgman propounded the possible existence of a new emf generated in a conductor carrying a current due to a time-varying temperature. This emf was not detected by any researchers due to the fact that the magnitude of this generated voltage is very small under normal conditions. However, under the conditions of an exploding wire the magnitude of the emf can become increasingly important. It is shown that this effect can account for the excess energy required to melt and vaporize a wire under the extreme conditions of a rapid discharge. Author

N64-30183 Avco Corp., Wilmington, Mass. Research and Advanced Development Div.
COMPARATIVE ABLATION TESTS OF ARC-DEPOSITED AND PYROLYTIC GRAPHITE SLENDER CONES (TASK 4.2–HIGH PERFORMANCE TIP MATERIALS–REST PROGRAM)
M. H. Fontana and P. R. Ammann 14 Jul. 1964 36 p
(Contract AF 04(694)-498)
(RAD-TM-64-30; AD-443909)

Two slender cones, each composed of arc-deposited graphite and pyrolytic graphite, were tested in the 10-mw arc facility. The nose radius was 0.250 in. and the cone half angle 10°, but the oriented graphite thicknesses were slightly different for the two materials. In the exhaust of a Mach 2 nozzle of the 10-mw arc, the cones experienced hot wall fluxes of 3,000 Btu/ft^2-sec for approximately 8 sec. The arc-deposited graphite specimens ablated uniformly, with one specimen showing some flaking at the nose-tip region; however, no gross mechanical failure occurred. The pyrolytic graphite specimens showed considerable blunting at the tip due to mechanical failure, and in one specimen a large section of the cone spalled off several seconds after the test began. Author

N64-30206 Lincoln Lab., Mass. Inst. of Tech., Lexington
BEAM PULSE HEATING
E. Silverman 13 Apr. 1964 26 p refs
(Contract AF 19(628)-500; ARPA Order-85; Proj. Defender)
(TR-351; AD-443662)

Experiments are described that investigated the single-pulse, instantaneous surface temperatures of metallic materials subjected to high-intensity, pulsed electron-beam bombardment. The metallic vapors liberated from these bombarded areas may be deposited on critical surfaces within a high-power microwave tube and thereby limit peak power output. A photoelectric pyrometer to monitor the instantaneous temperature is described, and the difficulties with the bremsstrahlung intensity extending within the wavelength limits of the photomultiplier instrumentation are discussed. The predicted and measured surface temperatures for the metals investigated are compared. Author

14 HUMAN BEHAVIOR

Includes crew training and evaluation; piloting; and psychological factors. *For simulators see*: 10 Facilities, Research and Support. *For related information see*: 16 Life Sciences.

N64-29206* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
CREW PERFORMANCE DURING REAL-TIME LUNAR MISSION SIMULATION
Howard G. Hatch, Jr., Joseph S. Algranti; Donald L. Mallick, Harold E. Ream, and Glen W. Stinnet (NASA. Ames Res. Center) Washington, NASA, Sep. 1964 48 p refs
(NASA-TN-D-2447) OTS: $1.25

In order to study the performance of a crew in prolonged space flight, a simulation was made of a lunar landing mission beginning with launch from earth and terminating after earth reentry. Three trained test pilots, enclosed in two interconnected mockups of a command module and a lunar orbit rendezvous vehicle, flew three realistically simulated missions. Piloting performance was evaluated by comparison of accuracies achieved during the simulated missions with the base-line data obtained during training. The areas evaluated included crew proficiency in normal mission duties, crew alertness to emergency situations, the effects of duty cycles and physical conditioning, and crew psychophysiological reaction. Author

N64-29247 Applied Science Associates, Inc., Valencia, Pa.
DEVELOPMENT OF AN IMPROVED METHOD OF TASK ANALYSIS AND BEGINNINGS OF A THEORY OF TRAINING
John D. Folley, Jr. 22 Jun. 1964 44 p refs
(Contract N61339-1218)
(NAVTRADEVCEN-1218-1; AD-445869)

The purpose of this study was to devise an effective method of task analysis that would fit in with a larger program of training-device development. Four major results were obtained: (1) a set of guidelines for task analysis that include background material thought to be useful to the task analyst (e.g., the nature of the task analysis and the nature of the task analyst): an overview of the process of task analysis; samples of forms to be used in task analysis; instructions on what information to obtain, how to get it, and where and how to record it; and examples of completed portions of a task analysis; (2) a system of interrelated definitions, constructs, and hypotheses relating task attributes to training requirements; and (3) recommendations for further research to improve task analysis and training-situation analysis. I.v.L.

N64-29277 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STUDYING THE PSYCHOLOGICAL ASPECTS OF MAN'S RELIABLE FUNCTIONING IN COSMIC FLIGHT
M. I. Bobneva 6 Aug. 1963 22 p refs Transl. into ENGLISH from Vopr. Psikhologii (Moscow), no. 2, 1963, p. 173–180
(FTD-TT-63-761/1+2; AD-420604)

This report covers the following areas: (1) engineering psychology and problems of stress and dependability; (2) the cosmonaut—operator of a technical system; (3) work under conditions of time loss and in the presence of many sources of information; (4) reliability and information when the operator is overloaded with information, and compensatory processes; (5) reliability and information when the operator is underloaded with information, and compensatory processes; and (6) dependability and distribution of functions between man and machine. I.v.L.

N64-29280 HRB-Singer, Inc., State College, Pa.
THE ENHANCEMENT OF FIRE CONTROL TECHNICIAN PROFICIENCY BY THE USE OF TRAINING DEVICES
T. P. Enderwick, J. M. Mc Kendry, and M. S. Mc Kendry Apr. 1964 182 p refs
(Contract N61339-1105)
(NAVTRADEVCEN-1105-1; AD-446397)

This report considers the question of how instructional devices can be used to increase the proficiency of individuals

assigned the task of maintaining complex electronic fire-control equipment in the fleet (FTs). This question was studied in relation to particular equipments comprising the Mark 68 fire-control system. However, where possible, an attempt was made to generalize findings to other fire-control systems.
Author

N64-29650 National Academy of Sciences-National Research Council, Washington, D.C. NRC Committee on Vision
VISUAL REQUIREMENTS FOR FLYING: SOME ASPECTS OF RE-EVALUATION Report of Working Group 20
Arthur Jampolsky and Ailene Morris Jun. 1964 27 p refs
(Contract Nonr-2300(05))
(AD-442707)

The conclusions and recommendations of a working group to reevaluate the visual requirements for flying are presented. Among the conclusions drawn are these: (1) Increased flexibility and refinement of the visual classification system are required. (2) The feasibility and actual need for extensive validation of visual standards in terms of specific performance are questioned. (3) Communication is inadequate, and the liaison is poor between operational visual specialists and visual scientists. Among the recommendations are the following: (1) to state the capabilities in each of the major visual parameters in grades of visual fitness as a basis for a flexible dynamic system of visual standards; (2) to create a core team of operational visual specialists and visual scientists to carry out the grades of visual fitness concept; (3) to define perfection in each of the visual parameters; (4) to evaluate and recommend improved visual testing techniques; (5) to recognize the value of pooled, expert judgment in lieu of elaborate validation studies; and (6) to organize questions and data according to the principles of taxonomic classification, in order to facilitate communication between operational and scientific personnel. Methods and principles of taxonomic classification applied to human visual data are included in a supplement.
M.P.G.

N64-29659 Illinois U., Urbana
THREE-WAY FACTOR ANALYSIS OF A MULTITRAIT-MULTIMETHOD MATRIX
Edward L. Hoffman and Ledyard R. Tucker Feb. 1964 40 p refs
(Contract Nonr-1834(39))
(AD-600302) OTS: $1.00

Analytical procedures, developed from Tucker's model for the analysis of three-way matrices of data, were applied to a multitrait–multimethod correlation matrix of rating-scale data from the Kelly and Fiske study of Veteran's Administration trainees. Ratings of the trainees on 15 of the original 22 variables, by the assessment staff, by the trainees' teammates during the assessment period, and by the trainees themselves, were analyzed for 124 male trainees. A major conclusion drawn from the findings is that, as applied to this set of data, Tucker's model appears to be more powerful than previously used methods, since it discloses the intrinsic structure existing in the observational mode of the data, while providing a quantitative description of the interrelationships among these intrinsic structures.
D.E.W.

N64-29676 Tufts U., Medford, Mass. Inst. for Psychological Research
HUMAN ENGINEERING BIBLIOGRAPHY, 1961–1962
Paul G. Ronco et al Washington, ONR, Oct. 1963 398 p refs
(Contract Nonr-494(13))
(ONR-ACR-86; AD-602386) OTS: $5.00

This bibliography comprises the following: (1) a topical outline that defines over 300 topic headings established for this bibliography; (2) an alphabetic index of the common search terms that would aid those using this bibliography but who are unfamiliar with the topic headings; (3) an annotated bibliography of some 1,745 citations; and (4) an index of the authors of these citations.
Author

N64-29751 United Aircraft Corp., Farmington, Conn. Systems Center
HUMAN ENGINEERING CONSIDERATIONS IN TACTICAL METEOROLOGICAL EQUIPMENT
Stephen D. Benson and Robert L. Hilgendorf Bedford, Mass., Electron. Systems Command, Jun. 1964 13 p Presented at the 10th Meeting of the Army Integrated Meteorol. System Coordinating Group, Waltham, Mass., 21 May 1964
(Contract AF 19(628)-3357)
(ESD-TDR-64-437; AD-602711) OTS: $1.00

This report concerns human capabilities and limitations as they interface with the operation, maintenance, and control of tactical meteorological equipment. It discusses several pieces of tactical meteorological equipment and relates to these equipment their major "human engineering" problems and concerns.
Author

N64-29762 Matrix Corp., Arlington, Va.
USE OF AN ENGINEERING ANALOGY IN THE DEVELOPMENT OF TESTS TO PREDICT TRACKING PERFORMANCE
James F. Parker, Jr. Feb. 1964 60 p refs
(Contract Nonr-3065(00))
(AD-602861) OTS: $3.00

This study attempted to describe performance in a complex perceptual-motor task (the criterion tracking task) in terms of a limited number of basic abilities. An engineering analogy of the criterion task was developed and was used to specify the basic activities involved. These, in turn, were used in hypothesizing a set of abilities believed to underlie task proficiency. Paper-and-pencil, electronic, and mechanical tests were constructed for each hypothesized ability, with the hope that these tests would serve as predictors of performance in the tracking task. One hundred subjects were measured on the predictor tests and were practiced in the tracking task for a total of 8 hours, distributed over 6 weeks. The seven factors that could be extracted from the derived matrix factor provided a considerable degree of validation of the engineering analogy. A time-sharing ability was identified, but was not found to relate to tracking performance. Three of the remaining factors did relate to tracking performance, accounting among them for approximately 50% of criterion task variance. Of these, the ability to operate foot controls measured motor responses. The ability to predict movement through time and the ability to analyze target movement measured the prediction responses.
I.v.L.

N64-29766 Flying Personnel Research Committee (Gt. Brit.)
THE BISENSORY PRESENTATION OF INFORMATION. PART I: A REVIEW OF EXPERIMENTS ON SENSORY INTERACTION
John Brebner, (St. Andrews U.) London, Min. of Aviation, Apr. 1963 30 p refs
(FPRC/1209(a))

Investigations that have been carried out in the field of intersensory phenomena are reviewed, and areas of apparent conflict in results obtained and areas of agreement between disparate sets of results are pointed out. Topics covered include threshold and acuity alterations, auditory flutter and critical flicker fusion, dark adaptation, color vision, vigilance

and simultaneous presentations, bisensory presentation of information, auditory localization, temporal considerations, and crossmodal comparisons. P.V.E.

N64-29767 Flying Personnel Research Committee (Gt. Brit.)
THE BISENSORY PRESENTATION OF INFORMATION. PART II: THE EFFECT OF SIMULTANEOUS AUDITORY STIMULATION ON THE DETECTION OF VISUAL SIGNALS
John Brebner (St. Andrews U.) London, Min. of Aviation, Jul. 1963 11 p refs
(FPRC/1209(b))

Experiments were conducted to ascertain whether the detection of weak visual signals was improved when they were accompanied by an auditory signal in a situation where a "liberal" strategy was inappropriate. The auditory signal was selected to have a detection probability of 1. Both auditory and visual signals were derived from the same source—a white-noise generator producing an output with a level spectrum over the audio band above 100 c/s. Three groups of six males acted as subjects. The mean-age of Group I was 20.5 years; that of Groups II and III was 20.3 years. In Group I, with signals 10 db down from their threshold level, bisensory presentation reduced the number of correct detections. In Group II, with signals 5 db down from their threshold level, the number of correct detections differed little between bisensory and unisensory detection. In group III, the detectability of visual signals was improved when they were accompanied by auditory signals at the suprathreshold level. I.v.L.

N64-29794 Illinois U., Urbana Aviation Psychology Lab.
EFFECTS OF VISUAL DISPLAY MODE ON SIX HOURS OF VISUAL MONITORING
Carl E. Webber and Jack A. Adams Brooks AFB, Tex., School of Aerospace Med., Jun. 1964 14 p refs
(Contract AF 41(609)-1481)
(SAM-TDR-64-34; AD-604466)

An experiment was performed to assess the effects of visual display mode and 6 hours of monitoring on performance in a complex vigilance task. The task had 12 stimulus sources arrayed over 60 degrees, and numeric signals that persisted for 6 seconds. Each group of 15 subjects had a different display configuration: normally off, normally on, and normally on with visual noise. Display mode influenced overall mean performance, but not vigilance decrement. The amount of vigilance decrement was small despite the long session, and its magnitude was essentially the same as previous studies with sessions of 2- to 3-hours' duration. Findings supported earlier conclusions about the triviality of vigilance decrement when tasks are complex. Author

N64-29814 Massachusetts U., Amherst Inst. of Environmental Psychophysiology
THE EFFECT OF VARIOUS MODES OF REHEARSAL ON SHORT-TERM RECALL
Mary Eleanor Lewis and Warren H. Teichner 11 Jun. 1964 27 p refs
(Contract N611339-1303)
(NAVTRADEVCEN-1303-1; AD-605387)

This report is one of 3 evaluations of different proposed methods for increasing the ability of individuals to report the contents of briefly exposed alphabetic displays. In this case, study was made of the effects on short-term recall of the last and next-last display in a rapid series of the following modes of rehearsal: (1) silent rehearsal; (2) vocal rehearsal; (3) manual rehearsal; and (4) combined vocal–manual rehearsal. The results suggested that rehearsal aids when memory is severely stressed, as for recall of the next-last display, and that vocal rehearsal is superior to the other modes studied. The military implications of the results are discussed. Author

N64-29847 Federal Aviation Agency, Oklahoma City, Okla. Civil Aeromedical Research Inst.
TASK-CONTROL OF AROUSAL AND THE EFFECTS OF REPEATED UNIDIRECTIONAL ANGULAR ACCELERATION ON HUMAN VESTIBULAR RESPONSES
William E. Collins Nov. 1963 28 p refs
(CARI-63-29; AD-603419)

Subjects were exposed to a 10-day habituation series of 200 CW accelerations in total darkness while performing attention-demanding tasks. Decelerations were subthreshold. Preliminary and post-tests indicated that slow-phase nystagmus and duration of the ocular response declined bidirectionally as a function of the habituation trials, but frequency of nystagmus increased during the stimulus period and for a few seconds thereafter. These changes were approximately equal for both CW and CCW stimulation. A decline in the intensity of the sensation to CW acceleration, but not to CCW stimulation, was produced by the habituation series. Author

N64-29848 Federal Aviation Agency, Oklahoma City, Okla. Civil Aeromedical Research Inst.
PROBLEMS IN AIR TRAFFIC MANAGEMENT. IV. COMPARISON OF PRE-EMPLOYMENT, JOB-RELATED EXPERIENCE WITH APTITUDE TESTS AS PREDICTORS OF TRAINING AND JOB PERFORMANCE OF AIR TRAFFIC CONTROL SPECIALISTS
David K. Trites and Bart B. Cobb Dec. 1963 13 p refs
(CARI-63-31; AD-603416)

In general, experience most directly related to air traffic control work was a positive predictor; experience related to communications and piloting was negative. It was also shown that for enroute trainees only, a composite variable (ΣAT) representing the sum of tower GCA, RAPCON/RATCC, and center experience had a statistically significant, but small, relationship with ratings of job performance. In contrast, aptitude tests were superior to the experience variables for the prediction of all training course performance measures of both types of trainees, with the exception of laboratory performance of terminal trainees. Author

N64-29849 Federal Aviation Agency, Oklahoma City, Okla. Civil Aeromedical Research Inst.
WORK TOLERANCE: AGE AND ALTITUDE
D. B. Dill, S. Robinson, B. Balke, and J. L. Newton Dec. 1963 10 p refs
(CARI-63-33; AD-603932)

The work capacity of nine men has been measured on the treadmill and/or on the bicycle ergometer at sea level and at high altitude; five of these men were studied at intervals 18 to 33 years apart. The maximum capacity for oxygen intake declined with age, both at high altitude and at sea level. Individual responses varied greatly: the most fit individual, age 54, had about as great an oxygen intake on the ergometer at an altitude of 14,200 ft (P_B = 455-mm Hg) as had a man one-half his age at sea level. After 5 to 6 weeks of acclimatization a man of 71 attained at the elevation of 12,600 ft (P_B = 485-mm Hg) a greater oxygen intake per kg and per min than a man of 27. Author

N64-29850 Federal Aviation Agency, Oklahoma City, Okla. Civil Aeromedical Research Inst.

HUMAN FACTORS ASPECTS OF LIGHTPLANE SAFETY

Richard G. Pearson Dec. 1963 15 p refs

(CARI-63-35; AD-603931)

This paper attempts to relate aircraft accident investigation and aeromedical research efforts for the purpose of clarifying research needs. Such efforts ultimately can lead to a reduction in lightplane accidents, injuries, and fatalities. Recent statistical studies of lightplane crash injuries are summarized, and contributions that human biologists, physical anthropologists, and design engineers can make toward reducing or preventing injury in future crashes are discussed. Programs of biomedical and human engineering research as they relate to lightplane safety are described. Contributions that physicians can make to this program are outlined. Author

N64-29871 Massachusetts U., Amherst Inst. of Environmental Psychophysiology

PERCEPTION AND SHORT TERM MEMORY UNDER WORK LOAD STRESS

Robert Seibel, Richard E. Christ, and Warren H. Teichner 11 Jun. 1964 33 p refs

(Contract N61339-1303)

(NAVTRADEVCEN-1303-2; AD-604866)

The effect that systematically increasing the rate of input information has on short-term memory was investigated. It was found that relatively high levels of input-load stress did not lead to the expected breakdown in the critical memory task. The findings suggest that operators adapt to the high-input rates by encoding the data, i.e., imposing their own unique organization on the incoming material, thus facilitating assimilation and processing of large amounts of unconnected, meaningless material. One implication of these results is that greater attention should be focused on problems of storage and output processing (rather than on input rate) in training for and design of high-speed man–machine closed-loop systems. M.P.G.

N64-29918 George Washington U., Washington, D.C. Human Resources Research Office

HumRRO WORK PROGRAM, FISCAL YEAR 1965: RESEARCH AND DEVELOPMENT IN TRAINING, MOTIVATION, AND LEADERSHIP

30 Jun. 1964 146 p

(Contract DA-44-188-ARO-2)

(AD-446448)

This report is divided as follows: (1) Individual Training for Equipment Operation and Maintenance; (2) Orientation and Training in Army Training Centers; (3) Small Unit Training; (4) Training for Leadership, Command, and Control; (5) Language and Area Training; (6) Training Technology; and (7) Basic Research. A.W.

N64-29947 Army Personnel Research Office, Washington, D.C.

CERTITUDE JUDGMENTS AND ACCURACY OF INFORMATION ASSIMILATION FROM VISUAL DISPLAYS

Robert S. Andrews, Jr. and Seymour Ringel May 1964 32 p refs

(USAPRO-TRN-145; AD-601971)

The present study was conducted to determine the extent to which certitude coincides with the accuracy of information assimilation and the extent to which the two are similarly affected by pertinent display variables. Certitude and accuracy were studied in relation to two information characteristics—amount of information presented and extent of change introduced in updating. The experimental design, conduct of the experiment, and statistical analysis are described. Viewers' certitude and the accuracy of their information assimilation corresponded most closely when the smallest amount of information was presented and the least change was made in updating. As amount of information increased, average accuracy and average certitude both decreased. However, increased change in updating reduced certitude but had negligible effect on accuracy. An 8-point scale, qualitatively labeled, provided a reliable measure of certitude. Author

N64-30018 Purdue U., Lafayette, Ind. Control and Information Systems Lab.

AN ADAPTIVE MODEL OF THE HUMAN OPERATOR IN A CONTROL SYSTEM

K. S. Fu and D. E. Knoop Sep. 1964 141 p refs

(Grants AF-AFOSR-62-351; NSF GP-2183; NSF GP-1872)

(TR-EE64-15; PRF-3810)

The input–output data are analyzed of a human operator engaged in a time-varying control situation. A mathematical model, functionally equivalent to the subject's performance, is synthesized. The type of control situation considered was that of one-dimensional, compensatory visual-manual tracking. A.W.

N64-30094* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

SOME OBSERVATIONS DURING WEIGHTLESSNESS SIMULATION WITH SUBJECT IMMERSED IN A ROTATING WATER TANK

Ralph W. Stone, Jr. and William Letko Washington, NASA, Sep. 1964 22 p refs

(NASA-TN-D-2195) OTS: $0.50

An investigation was made with a rotating water tank to determine the feasibility of the water-immersion technique for weightlessness simulation, including an attempted elimination of the otolith cues by rotation. Because of the early orbital flights the experiments were not continued and the technique was not fully evaluated; however, the experiences encountered are believed to be of general interest and of some possible physiological consequence. Author

N64-30148 Naval School of Aviation Medicine, Pensacola, Fla.

PERSONALITY ORIENTATION AND SUCCESS IN NAVAL AVIATION TRAINING

Richard W. Shoenberger 12 Dec. 1963 7 p refs

(Rept.-38; AD-434922)

The relationship between personality orientation, as measured by Bass' SIT Inventory, and success in naval aviation training was investigated. This was done as an evaluation of the SIT Inventory as a possible addition to the aviation selection test battery. Results showed that SIT scores bear little relationship to success in naval aviation training, and it was concluded that the addition of the SIT Inventory to the selection battery would not increase prediction validity. Author

N64-30199 Instrument Pilot Instructor School, Randolph AFB, Tex.

CONTROL-DISPLAY PILOT FACTORS PROGRAM

Dec. 1963 111 p refs

(AD-441953)

Intervening levels of control between full manual and full automatic were examined for the purpose of determining the compatibility of the human pilot with an automatic flight-control system using force wheel steering as the link between the two elements. Two identically equipped T-39 aircraft were utilized in the inflight examination. Twenty-six pilots representing commercial airlines, FAA, and the USAF flew every possible combination of the two levels of control in pitch, and three levels of control in roll, a total of five times; two times were for training and three times for record. A reduction in pilot workload, unburdening, was obtained as a function of increasing levels of automation. Author

15 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gauges; sensors and transducers; and telescopes and cameras. *For related information see*: 06 Auxiliary Systems; 08 Communications; 09 Electronics; and 22 Navigation and Guidance.

N64-29019 Lincoln Lab., Mass. Inst. of Tech., Lexington
MACHINE PERCEPTION OF THREE-DIMENSIONAL SOLIDS
L. G. Roberts 22 May 1963 44 p refs
(Contract AF 19(628)-500)
(TR-315; AD-407965)

In order to enable a computer to construct and display a three-dimensional array of solid objects from a single two-dimensional photograph, the rules and assumptions of depth perception have been carefully analyzed and mechanized. It is assumed that a photograph is a perspective projection of a set of objects that can be constructed from transformations of known three-dimensional models, and that the objects are supported by other visible objects or by a ground plane. These assumptions enable a computer to obtain a reasonable, three-dimensional description from the edge information in a photograph by means of a topological, mathematical process. A computer program has been written that can process a photograph into a line drawing, transform the line drawing into a three-dimensional representation, and finally, display the three-dimensional structure with all the hidden lines removed, from any point of view. Author

N64-29126 Joint Publications Research Service, Washington, D.C.
INSTRUMENT BUILDING, NO. 2, 1964
24 Aug. 1964 228 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Priborostr. (Leningrad), v. 7, no. 2, 1964 p 3–176
(JPRS-26079; TT-64-41349) OTS: $6.00

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N64-29127 Joint Publications Research Service, Washington, D.C.

ON CALCULATING THE SCALE OF AN RC-GENERATOR

B. N. Bukhanets *In its* Instr. Bldg., No. 2, 1964 24 Aug. 1964 p 1–8 refs (See N64-29126 21-15) OTS: $6.00

Analytic and graphic methods for calculating the scale of an RC-generator are given. The methods proposed make it possible to determine the necessary characteristics of the links for obtaining the given scale characteristics very simply. The graphic method is illustrated by an example. Author

N64-29128 Joint Publications Research Service, Washington, D.C.

A STABLE TRANSISTOR-TUBE RC-GENERATOR

Yu. G. Kochinev *In its* Instr. Bldg., No. 2, 1964 24 Aug. 1964 p 9–15 refs (See N64-29126 21-15) OTS: $6.00

Discussed is an RC-generator circuit composed of transistors and a plug-in tube, having high frequency stability in a wide range of temperature changes. The temperature instability of the amplitude of the oscillations is studied. Experimental data of the frequency and amplitude are given as functions of temperature. Author

N64-29129 Joint Publications Research Service, Washington, D.C.

INVESTIGATION OF THE INERTNESS AND SENSITIVITY OF A DRIFT PHOTOTRIODE

V. V. Novikov *In its* Instr. Bldg., No. 2, 1964 24 Aug. 1964 p 16–23 refs (See N64-29126 21-15) OTS: $6.00

The transient and fixed processes in drift phototriodes are considered. The results of an experimental investigation are given, which confirm the functions obtained. Ways are indicated for improving the design of a drift phototriode for the purpose of decreasing its inertness and increasing its sensitivity. Author

N64-29130 Joint Publications Research Service, Washington, D.C.

CALIBRATION AND CONTROL OF AMPLITUDE VOLTAGE ANALYZERS

A. S. Mkrtchyan *In its* Instr. Bldg., No. 2, 1964 24 Aug. 1964 p 24–26 (See N64-29126 21-15) OTS: $6.00

In prolonged operation of multichannel amplitude voltage analyzers, the necessity arises of periodically making a check and correcting the level of discrimination of the individual channels in these analyzers. The method of calibration and control of the operation of the discriminators proposed makes it possible, by means of simple equipment, to estimate rapidly the measurement errors in the signal amplitude by the amplitude analyzers, and also to calibrate the amplitude discriminators and the voltage analyzers. Author

N64-29131 Joint Publications Research Service, Washington, D.C.

A PHOTOELECTROMETRIC COMPENSATOR

B. K. Grigorovskiy *In its* Instr. Bldg., No. 2, 1964 20 Aug. 1964 p 27–36 (See N64-29126 21-15) OTS: $6.00

Considered is a photoelectrometric compensator with the use of an electrometer as the primary measuring mechanism, making it possible to measure small voltages at a relatively large input resistance of the instrument. The operating principles, the bases of the theory, and the technical characteristics of the instrument are given. Author

N64-29132 Joint Publications Research Service, Washington, D.C.

ON THE THRESHOLD SENSITIVITY OF A GALVANOMETRIC AMPLIFIER WITH A MUTUAL INDUCTIVITY CONVERTER

Ye. A. Kiseleva *In its* Instr. Bldg., No. 2, 1964 24 Aug. 1964 p 37–45 refs (See N64-29126 21-15) OTS: $6.00

Factors determining the theoretical sensitivity threshold of a galvanometric amplifier with a mutual inductivity converter having a pulsating field are considered. The effect of mechanical factors on the sensitivity of the instrument is analyzed. Author

N64-29133 Joint Publications Research Service, Washington, D.C.

ON THE CALCULATION OF MEASURING CIRCUITS OF ELECTRONIC AUTOMATIC BALANCED BRIDGES

A. A. Kol'tsov and D. N. Karabanov *In its* Instr. Bldg., No. 2, 1964 24 Aug. 1964 p 46–54 refs (See N64-29126 21-15) OTS: $6.00

Methods of calculating bridge circuits of automatic instruments are presented, based on preliminary determination of certain circuit parameters. A rheochord is installed in the circuit, and the magnitude of the resistances of the inactive sections of the rheochord are determined for the specific instrument being studied. The minimum resistance of the R-circuit (which may or may not include a resistance thermometer) is then the determining quantity. A tabulated summary of formulas for determining the resistances of circuits, as well as expressions for determining the nature of the bridge scales and their voltage sensitivity, is included. M.P.G.

N64-29134 Joint Publications Research Service, Washington, D.C.

ON THE PROBLEM OF CALCULATING A FERRODYNAMIC GALVANOMETER

O. I. Ul'yanov *In its* Instr. Bldg., No. 2, 1964 24 Aug. 1964 p 55–63 refs (See N64-29126 21-15) OTS: $6.00

The calculation materials, formulas, and graphs given make it possible to perform a rational selection of the parameters of a galvanometer for any given conditions of its operation in a compensator circuit. Author

N64-29135 Joint Publications Research Service, Washington, D.C.

ON THE APPLICATION OF A SINGLE-CIRCUIT PARAMETRIC GENERATOR IN A NUCLEAR MAGNETIC RESONANCE APPARATUS

V. F. Kushnir and G. N. Solopchenko *In its* Instr. Bldg., No. 2, 1964 24 Aug. 1964 p 64–69 refs (See N64-29126 21-15) OTS: $6.00

The circuitry, theory, and application of a parametric generator for nuclear magnetic resonance studies are discussed. The generator described may be used in several digital amperemeters and magnetometers. The results of experimental testing indicate the following: (1) The sensitivity of a parametric

generator, operating with automatic bias, increases as detuning increases toward positive values (in the region of stable generation). (2) A superregenerative operating regime to increase the sensitivity can be created by modulation of the resonance frequency of the circuit. (3) An amplifier for the frequency meter is unnecessary, since the carrier frequency of the parametric superregenerator can be measured by a digital frequency meter. (4) The parametric generator offers no advantage in regard to noise in comparison with a tube generator of weak oscillations. M.P.G.

N64-29136 Joint Publications Research Service, Washington, D.C.

A DEVICE FOR AUTOMATIC INDICATION OF OPERATING FAILURES OF DISCRETE SYSTEMS

A. A. Bessonov and V. A. Sivakov *In its* Instr. Bldg., No. 2, 1964 24 Aug. 1964 p 70–78 refs (See N64-29126 21-15) OTS: $6.00

A description of two modifications of original testers, developed for automatic detection of failures of discrete systems, is given. The testers are made on the basis of only one standard flip-flop and effective comparing devices having a simple logic circuit. Author

N64-29137 Joint Publications Research Service, Washington, D.C.

ON POSSIBLE METHODS OF CONSTRUCTING STORAGE ADDERS ACTING IN SEQUENCE FROM FERRITE CORES

Ye. P. Balashov *In its* Instr. Bldg., No. 2, 1964 24 Aug. 1964 p 79–90 refs (See N64-29126 21-15) OTS: $6.00

Possible variations of the construction of binary storage adders acting in sequence and made from magnetic elements with a rectangular hysteresis loop are considered. The circuits are distinguished for their structural simplicity, the absence of complex logic connections, and small number of component elements, and can be recommended in the construction of highly reliable, moderately quick-acting devices for processing discrete information. Author

N64-29138 Joint Publications Research Service, Washington, D.C.

MODELING OF EXPONENTIAL AND LOGARITHMIC FUNCTIONS BY MEANS OF NON-LINEAR SEMICONDUCTOR RESISTORS

S. L. Korovitskiy and V. V. Pasynkov *In its* Instr. Bldg. No. 2, 1964 24 Aug. 1964 p 91–100 refs (See N64-29126 21-15) OTS: $6.00

In general, the accuracy of the operation of a functional converter depends upon the selection of the correcting circuit, the parameters of the nonlinear semiconductor resistors (NPS), and the magnitudes of the linear resistances. The correcting circuit selected is adequately simple so that tuning of the functional converter causes no difficulties and provides for a high accuracy of reproduction. For the types of NPS considered, the error in the entire interval does not exceed 0.5% and only in individual cases reaches as much as 1% of the maximum value of the output voltage. The calculations given make it possible to determine the values of the correcting resistances with respect to the basic parameters of the NPS. The results of the calculation coincides well with the experimental data. Author

N64-29139 Joint Publications Research Service, Washington, D.C.

GENERALIZED CHARACTERISTICS OF A MULTI-CHANNEL SEMICONDUCTOR VOLTAGE-TO-CODE CONVERTER WITH DIGIT-BY-DIGIT CODING

E. I. Gitis and Ye. G. Pronin *In its* Instr. Bldg., No. 2, 1964 24 Aug. 1964 p 101–110 refs (See N64-29126 21-15) OTS: $6.00

The validity of the method of generalized characteristics in ascertaining the time and operational characteristics of converters is demonstrated. A converter with digit-to-digit coding is analyzed as an example, but the method can be applied to other types of converters. The method consists of dividing a multichannel converter into two types of elementary units: (1) amplifying units, such as flip-flops, key control circuits, etc., all of which have two stable states, whose time characteristics are determined by their settling time, and whose operational characteristics are determined by the sum of the number of active and passive elements entering into the circuit of the unit; and (2) analogy units, such as voltage commutation keys, sawtooth voltage generators, etc., whose time and operational characteristics depend upon the required conversion accuracy. The time and operational characteristics of the converter are then determined from the number of units of each type, the number of input channels, and the number of digits in the output code. The results are useful in selecting the type of converter that will have the minimum interval between the conversion cycles and the minimum volume of the apparatus. M.P.G.

N64-29140 Joint Publications Research Service, Washington, D.C.

AUTOMATIC INSTRUMENTS AND DEVICES WITH STEP-BY-STEP CONTROL MOTORS

Sh. Yu. Ismailov, A. M. Smolyarov, and Ye. M. Dondik *In its* Instr. Bldg., No. 2, 1964 24 Aug. 1964 p 111–119 refs (See N64-29126 21-15) OTS: $6.00

Several examples of the use of step-by-step control motors in instruments and systems are given to show the simplicity, reliability, rapidity of action, and precision that can be obtained. Among the applications described are automatic-control instruments for machine-tool building, regulators, remote transmission of an angle of rotation, automatic recording instruments, and servomechanisms. The use of step-by-step motors in these systems provides the possibility of not only reading but also recording; the pulse nature of the signal treatment permits the obtaining of measurement results in a digital form suitable for computer analysis. M.P.G.

N64-29141 Joint Publications Research Service, Washington, D.C.

ON THE CALCULATION OF A SELECTIVE AMPLIFIER WITH A DOUBLE T-SHAPED BRIDGE IN A FEEDBACK CIRCUIT

V. I. Zlatkin *In its* Instr. Bldg., No. 2, 1964 24 Aug. 1964 p 120–122 ref (See N64-29126 21-15) OTS: $6.00

A formula is proposed, and experimentally checked, for calculating corrections for resonance frequency drift of an amplifier because of phase shift introduced by an amplifier with a double T-shaped bridge in a negative feedback circuit. A simple formula is derived for determining corrections to the tuning frequency of the bridge from the known phase shift ϕ and the amplification factor K of the amplifier at the desired resonance frequency fres. Author

N64-29142 Joint Publications Research Service, Washington, D.C.

AN ASTATIC GYROSCOPE WITH DRY FRICTION IN THE AXES OF A GIMBAL INSTALLED IN A FIXED POSITION ON THE EARTH

N. V. Butenin *In its* Instr. Bldg., No. 2, 1964 24 Aug. 1964 p 123–132 refs (See N64-29126 21-15) OTS: $6.00

Precession equations are used to study the effect of the moments of the forces of dry friction on the apparent motion of an astatic gyroscope installed in a fixed position on the earth. Formulas are obtained for determining the boundaries of the regions of stagnation. These formulas, used with the equation of the integral curves, make it possible in each specific case to estimate the apparent motion of the gyroscope axis, depending upon the latitude of the locality and the magnitudes of the moments of dry friction. M.P.G.

N64-29143 Joint Publications Research Service, Washington, D.C.

ON THE THEORY OF A SINGLE-ROTOR GYROCOMPASS WITH ELECTROMAGNETIC CORRECTION

M. M. Bogdanovich *In its* Instr. Bldg., No. 2, 1964 24 Aug. 1964 p 133–142 ref (See N64-29126 21-15) OTS: $6.00

The effect of maneuvers of a vehicle on the readings of a gyrocompass with electromagnetic correction is considered. The sensitive elements of such gyrocompasses are described; the main axes of motion are compiled according to precessional theory; the components of the main moment of the forces of gravity and the forces of inertia are determined; and sources of instrumental error are considered. The analysis indicates that, with the inclination indicator switched off from the moment pickups, a gyrocompass operating with a great period will not have any ballistic deviation in the direction of the vehicle maneuver. M.P.G.

N64-29144 Joint Publications Research Service, Washington, D.C.

ON THE NATURAL DAMPING OF THE NUTATIONAL OSCILLATIONS OF A FREE GYROSCOPE

N. V. Gusev *In its* Instr. Bldg., No. 2, 1964 24 Aug. 1964 p 143–153 ref (See N64-29126 21-15) OTS: $6.00

The observed natural damping of the nutational oscillations of a free gyroscope, from the quantitative standpoint, cannot be explained by moments of friction in the supports of the gimbals or by the resistance of the ambient air. The decisive influence on the damping of nutational ocillations is that of the forces of friction resulting from microshifts at contact points of the gyromotor that originate under the influence or gyroscopic and inertial moments. With other conditions equal, the damping of nutational oscillations increases as a direct function of the kinetic moment and as an inverse function of the equatorial rigidity of the rotor flywheel connection with the gyrochamber. Author

N64-29145 Joint Publications Research Service, Washington, D.C.

A GYROCOMPASS WITH AN ELASTIC TORSIONAL SUPPORT

M. A. Sergeyev *In its* Instr. Bldg., No. 2, 1964 24 Aug. 1964 p 154–164 (See N64-29126 21-15) OTS: $6.00

A first approximation of the motion of the sensitive element of a gryrocompass with an absolutely elastic torsional support is presented. Seven coordinates are determined for the position of the sensitive element, and the equations of motion are determined with respect to the angular coordinate. The effect of the accompanying oscillations on the accuracy of the reading of the gyrocompass is calculated, and the following conclusions are drawn: (1) The period of free undamped oscillations can be determined in accordance with a formula similar to that for a pendulum gyroscope. (2) The accompanying oscillations, considering the present accuracy of gyrocompasses mounted on dry land, do not distort the precessional motion of the sensitive element in the azimuth. M.P.G.

N64-29146 Joint Publications Research Service, Washington, D.C.

AN INVESTIGATION OF A SMALL ELECTRIC CLOCK WITH AN INDIRECT-ACTION ELECTRIC DRIVE

Z. M. Aksel'rod *In its* Instr. Bldg., No. 2, 1964 24 Aug. 1964 p 165–175 refs (See N64-29126 21-15) OTS: $6.00

This paper considers a clock mechanism of small overall dimensions, with an indirect-action electric drive, in which a stable self-oscillatory regime is achieved that does not depend upon the voltage of the power supply. Formulas are obtained that express the dependence between the basic parameters of the clock mechanism and the effect of friction on the period and amplitude of the oscillator motions. Author

N64-29147 Joint Publications Research Service, Washington, D.C.

A PARALLELOGRAM INSTRUMENT FOR ACTIVE CONTROL

V. I. Kosov and A. I. Solov'yev *In its* Instr. Bldg., No. 2, 1964 24 Aug. 1964 p 176–180 refs (See N64-29126 21-15) OTS: $6.00

In this article are described the operating principles and construction of a two-contact parallelogram instrument for active control of diameters, which, in practice, almost excludes the effect of the pulsation of the product on the results of the measurement. Author

N64-29148 Joint Publications Research Service, Washington, D.C.

A SYSTEM OF THREE FLAT MIRRORS

G. V. Pogarev *In its* Bldg., No. 2, 1964 24 Aug. 1964 p 181–191 refs (See N64-29126 21-15) OTS: $6.00

The matrices of the canonical form of a three-dimensional system of three flat mirrors are derived for three of its possible variations—with the first, second, or third mirror skewed. It is shown that the variations of the three-mirror system have matrices of the same type, which in all cases are the matrices of a double mirror with an inverse sign. Author

N64-29149 Joint Publications Research Service, Washington, D.C.

A DEVICE FOR HIGH-SPEED RECORDING OF SMALL TEMPERATURE DROPS

Yu. N. Shimanskiy, L. K. Vasanova, V. M. Kirpichnikov, and N. I. Syromyatnikov *In its* Instr. Bldg., No. 2, 1964 24 Aug. 1964 p 192–196 refs (See N64-29126 21-15) OTS: $6.00

A device developed for recording rapidly changing low temperatures is described. An alternating current amplifier is used with a bridge circuit with a d.c. thermocouple, a 50-cps modulator, and an a.c. voltage amplifier, as well as a bridge demodulator and one amplification stage for the capacity. The cathode load uses d.c., and there is a vibrator oscillograph at the output. The device must be calibrated for every 5 to 6 hours of preheating of the power amplification stage, but the results of 6 days of testing for nonstability of calibrated factors (or zero drift) showed that the maximum deviation of the calibrated characteristics does not exceed 3%. M.P.G.

N64-29150 Joint Publications Research Service, Washington, D.C.

BASIC PROBLEMS IN THE GEOMETRY OF AN ORTHOGONAL NON-HYPOIDAL CYLINDROCONICAL TRANSMISSION

L. Ya. Liburkin *In its* Instr. Bldg., No. 2, 1964 24 Aug. 1964 p 197–204 refs (See N64-29126 21-15) OTS: $6.00

This work is devoted to an investigation of the geometry of an orthogonal nonhypoidal cylindroconical transmission, composed of a cylindrical evolvent pinion and a flat wheel, cut by an evolvent cog-wheel cutter. Author

N64-29151 Joint Publications Research Service, Washington, D.C.
AN INVESTIGATION OF CERTAIN TYPES OF SUPPORTS FOR THE SUSPENSIONS OF GYROSCOPIC INSTRUMENTS
I. M. Sivokonenko and K. N. Yavlenskiy *In its* Instr. Bldg., No. 2, 1964 24 Aug. 1964 p 205–213 refs (See N64-29126 21-15) OTS: $6.00

Results are given of investigations in the behavior of the suspensions of gyroscopic instruments in the presence of a forced motion of the central rings of bearings and bearing plates. Author

N64-29180* Plasmadyne Corp., Santa Ana, Calif.
INVESTIGATIVE STUDY ALONG WITH DESIGN AND DEVELOPMENT OF AN ULTRAVIOLET AIR DENSITY METER
Final Report
Delbert G. Van Ornum 19 Dec. 1963 77 p refs
(Contracts NAS5-427; NAS5-2184)
(NASA-CR-60002; FR123-427-2184) OTS: $7.60 ph

This report describes the design, fabrication, and testing of an air density meter based on the measurement of the backscatter of ultraviolet light. It was determined that intermediate ultraviolet near 0.2μ was particularly useful for measurements of this kind. Ambient atmospheric density measurements can be made at a position 2 m removed from the detection instruments during daylight, thus avoiding aerodynamic disturbances caused by shock waves, boundary layers, ionization, outgassing, gage aperture velocity vector, and gage chamber temperature. Author

N64-29193* Georgia Inst. of Tech., Atlanta Engineering Experiment Station
A SUBMILLIMETER INTERFERENCE SPECTROMETER
Final Technical Report
Wayne K. Rivers, Jr. 8 May 1964 44 p refs
(Grant NsG-258-62)
(NASA-CR-56839)

The principles of operation and construction of an interference spectrometer, which is intended to be used in the shorter millimeter and submillimeter region, are discussed. The instrument, which uses a wavefront dividing interferometer, has high resolving power for this region of the spectrum, one part in 500, making its especially useful at the longer wavelengths. Problems in the development of the instrument, including the mechanical design of the interferometer drive and the fabrication of microwave-optical elements peculiar to the instrument, are discussed. The results of limited tests performed are discussed. Included are spectra of a monochromatic source with a spectral resolution of 0.011 cm^{-1} (330 mc) and the transmission of a high-pass filter with spectral resolution of about 0.03 cm^{-1} Author

N64-29201* Sperry Farragut Co., Bristol, Tenn.
EXPERIMENTAL AB-5 GYRO PROGRAM Final Report
G. F. Ritchie 31 Aug. 1963 16 p
(Contract NAS8-5172)
(NASA-CR-58499; Publ.-3100-R319) OTS: $1.60 ph

Five distinct areas are investigated: (1) motor study and development; (2) magnetic shielding evaluation; (3) design completion of the unit frame gyro and delivery of a prototype unit; (4) an analytical and experimental temperature study of the unit frame gyro prototype and (5) electron beam welding evaluation. All areas except the experimental temperature study of the prototype gyro have been discussed in earlier reports but are summarized or referenced in this report. Results for the experimental temperature study appear for the first time and are reported in detail. Author

N64-29209 Joint Publications Research Service, Washington, D.C.
INVESTIGATIONS IN THE FIELD OF RADIOTECHNICAL MEASUREMENTS
6 Jul. 1964 51 p refs Transl. into ENGLISH from Issled. VObl. Radiotekhn. Izmereniy (Moscow), v. 48, no. 108, 1960 (JPRS-25358; TT-64-31631) OTS: $1.25

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1. STANDARD DC AUTOMATIC THERMISTOR BRIDGE L. M. Zaks p 3–24 refs (See N64-29210 21-15)
2. ANALYSIS OF THE ERRORS OF A MICROCALORIMETER WITH CIRCULATING LIQUID V. I. Pronenko p 25–48 refs (See N64-29211 21-15)

N64-29210 Joint Publications Research Service, Washington, D.C.
STANDARD DC AUTOMATIC THERMISTOR BRIDGE
L. M. Zaks *In its* Invest. in the Field of Radiotech. Meas. 6 Jul. 1964 p 3–24 refs (See N64-29209 21-15) OTS: $1.25

An automatic thermistor bridge is described, which, apart from allowing a comparatively high accuracy, also allows measurements to be taken in the entire, practically utilized range of work resistances of high-frequency thermistors of all types. The principles of this bridge, on the basis of its construction, are the following: d.c. current for thermistor heating, photocompensator amplifiers for automatic balancing or indication, electrodynamic instruments for the liquidation of scale nonlinearity, and a wide range of thermistor work resistances. I.v.L.

N64-29211 Joint Publications Research Service, Washington, D.C.
ANALYSIS OF THE ERRORS OF A MICROCALORIMETER WITH CIRCULATING LIQUID
V. I. Pronenko *In its* Invest. in the Field of Radiotech. Meas. 6 Jul. 1964 p 25–48 refs (See N64-29209 21-15) OTS: $1.25

Analyses were conducted of the following errors: (1) particular instrument errors; (2) error due to temperature instability; (3) error due to liquid-expenditure instability; (4) error due to the temperature drop indicator; (5) error of the replacing power measurement; (6) error due to the inequality of heat losses; (7) error due to SHF power losses in the supply channel; and (8) error due to SHF power reflections at the instrument input. I.v.L.

N64-29237 United Aircraft Corp., Sunnyvale, Calif. United Technology Center
CONSTRUCTION AND CALIBRATION OF UNITED TECHNOLOGY CENTER RADIATION HEAT METERS
Peteris Purgalis 19 Jun. 1963 15 p refs
(TM-14-63-U29)

Radiation heat meters of the slug calorimeter type were developed to measure incident radiation heat flux. The necessary calibration constants for the meters were found, together with a method for determining the useful range of measurements for the meters. Author

N64-29284 Sperry Gyroscope Co., Great Neck, N.Y. Electro-Optics Group

ELECTROMAGNETIC ANGULAR ROTATION SENSING Interim Engineering Report No. 1, 1 Jun.–31 Aug. 1963

D. Davis, W. Macek, R. Schneider, and G. White Sep. 1963 47 p

(Contract AF 33(657)-11433)

(AB-1108-0016-1; AD-418588)

Studies have been conducted on adapting the Sperry ring laser for rotation sensing. The investigations have been conducted at three different wavelengths—0.6328μ, 1.153μ, and 3.39μ—using the He-Ne gas system. Although higher gain is realized at 3.39μ and increased sensitivity at 0.6328μ, it appears that the 1.153μ laser is more suitable for experimental evaluation because of superior stability. Consequently, the more practical Faraday biasing technique is currently being designed for the 1.153μ system. Improvement of an order of magnitude has resulted from an alternate optical combiner, which inherently reduces energy coupling from one traveling-wave mode to the other. All results are in keeping with the qualitative hole-burning theory and nonlinear oscillation model that is discussed. Author

N64-29311 Magna Corp., Anaheim, Calif. Research and Technology Div.

THIN METAL FILM DETECTION SYSTEM Final Report, 15 Dec. 1962–15 Jun. 1963

Edwards AFB, Calif., Res. and Technol. Div., Jul. 1963 31 p ref

(Contract AF 04(611)-8527)

(RTD-TDR-63-1079; AD-418082)

Results are presented of work performed in the development of thin-film sensors for the detection of low concentrations of water in liquid nitrogen tetroxide. The effect of water concentration and temperature on the response rate of the films is presented. Responses, such as increase in sensor resistance, of 50 divisions per minute have been obtained for water concentrations of 0.1% by weight. Author

N64-29380 Naval Civil Engineering Lab., Port Hueneme, Calif.

LOW-FREQUENCY CURRENT-PROBE SYSTEM FOR MEASURING CONDUCTED RADIO-FREQUENCY INTERFERENCE

J. L. Brooks 25 Jun. 1964 53 p ref

(R-304; AD-601895)

A new approach to the problem of measuring conducted radiofrequency interference is described. An instrument has been developed that has the capability of measuring the impedance levels and noise currents of a power line or cord that is to be tested for conducted interference. The outstanding features of this instrument are its simplicity of operation in that the impedance magnitude and phase angle of the line are presented automatically on panel meters, and the completeness with which the conducted RFI may be measured. Either the noise-source impedance or the load impedance or both may be determined easily with this instrument. The design accuracy of the system is ±10 percent for the frequency range 20 kc to 2 mc and the impedance range from 10 to 10,000 ohms at 0° to 360°. Author

N64-29384* Harvard Coll. Observatory., Cambridge, Mass.

NEW DEVELOPMENTS OF THE FERROELECTRIC BOLOMETER FOR ASTRONOMICAL APPLICATION

Hector C. Ingrao, Frederic J. Kahn, and Donald H. Menzel Repr. from Memoires Soc. R. Sc. Liège, v. IX, Ser. 5 Harvard Reprint 651

(Grant 64-60)

Ceramic ferroelectric bolometers have been manufactured that have Curie points between $-10°$ C and $+10°$ C, and dimensions down to 0.5 mm × 0.5 mm × 50 microns. The performance has been measured of a radiation pyrometer that has a ferroelectric bolometer 1.0 mm × 10.0 mm × 0.2 mm, with an incident square-wave infrared signal of 5.8×10^{-9} watts peak-to-peak, mechanically chopped at 2.5 cps and a band pass $\Delta f = 0.25$ cps. The noise level of the system is 4.2×10^{-10} watts rms. Theoretical values of the responsivity and minimum detectable power of the detector are compared with experimental data. Author

N64-29389 National Aeronautical Lab., Bangalore (India)

PRESSURE TRANSDUCERS USING THE LINEAR DIFFERENTIAL TRANSFORMER

S. Balakrishna and S. Srinathkumar Jul. 1963 16 p refs

(TN-SE-3-63)

A pressure transducer is described that uses a linear variable differential transformer to sense the displacement at the center of a diaphragm subjected to the pressure being measured. Design details of the transducer are given, including complete specifications for the differential transformer and the electronic circuit used for indication. The diaphragm of the transducer is changed to get different full-scale pressure ranges. The accuracy of the transducer in all ranges is better than ±1 percent. Author

N64-29391 General Electric Co., Cincinnati, Ohio Nuclear Materials and Propulsion Operation

A RADIAL HEAT FLOW APPARATUS FOR HIGH-TEMPERATURE THERMAL CONDUCTIVITY MEASUREMENTS

A. D. Feith 31 Aug. 1964 27 p refs

(Contract AT(40-1)-2847)

(GEMP-296)

This report describes a steady-state radial heat flow apparatus for measuring the thermal conductivity of solid materials at temperatures up to 2,250° C. Thermal gradients were induced in a stack of 2-in.-diam discs by means of a resistively heated tubular heater that passed through a hole in the center of the discs. Protective atmospheres of hydrogen, argon, or helium were employed depending upon the particular material under study. Temperatures were measured by a Pt–Pt-10Rh thermocouple up to 1,200° C and by an optical pyrometer above this temperature. This technique was used to measure the thermal conductivity of the following materials: ZrO_2(CaO), BeO, $UO_{2.2} \cdot 3Y_2O_3$, $ZrO_2(Y_2O_3)$ + Zr, and Y_2O_3. Author

N64-29393 George Washington U., Washington, D.C. Center for Measurement Science

TWO-PORT FORMULATION OF ELECTROMECHANICAL TRANSDUCERS

Louis de Pian and Robert M. Moore 10 Jul. 1964 37 p refs

(Contract Nonr-761(09))

(Rept.-1; AD-602216)

This report begins with a discussion of analogies as they pertain to electromechanical transducers. Following this discussion, the linear operating equations of the general transducer are formulated as matrix equations, and the various possible matrix parameters and equivalent networks for such devices

are presented. The concept of reciprocity, nonreciprocity, and antireciprocity are then introduced, and their significance is discussed. Finally, a general development of the salient properties of linear electromechanical transducers, including natural (transient) and forced (steady state) response behavior, is developed, and the techniques are illustrated. Author

N64-29394 Canadian Armament Research and Development Establishment, Valcartier
OPERATION OF RADIOMETERS ON THE CARDE HYPERSONIC RANGES. PART II ABSOLUTE CALIBRATION
J. G. G. Dionne and G. Trottier Aug. 1964 24 p refs
(ARPA Order 133)
(CARDE-TR-500/64)

This report describes the method used to calibrate radiometers used on the CARDE hypersonic ranges. This method is characterized by the fact that the source-to-radiometer distance and the observation time are short. It is developed and applied to the calibration of radiometers covering the ultraviolet, visible, and infrared parts of the electromagnetic spectrum. Author

N64-29421 Texas U., Austin Defense Research Lab.
[DESIGN AND CONSTRUCTION OF TWO TYPES OF SEISMOMETERS] Quarterly Status Report, 1 May–31 Jul. 1964
20 Aug. 1964 12 p
(Contract CGS-1198)
(QSR-3)

Work has continued on the design and construction of two types of seismometers. The construction of a vertical solion seismometer is nearly finished, and the construction of a reduced-size horizontal solion seismometer is also nearing completion. Shake table experiments were performed. Also, the EV-100 short-period vertical seismometer and the solion seismometer were used simultaneously for comparative recording of microseisms. Author

N64-29501 Cutler-Hammer, Inc., Melville, N.Y. Airborne Instruments Lab.
SOLID-STATE FERROELECTRIC ACCELEROMETER Interim Report, 4 Feb.–4 May 1964
M. L. Wright and M. M. Freundlich 12 Jun. 1964 24 p refs
(Contract NOw-64-0093-c)
(IR-2; AD-601969)

The construction and resolution potential of the following are discussed: (1) a fringe-counting accelerometer breadboard; (2) a multipass accelerometer breadboard; and (3) manually operated single-fringe resolving systems. In addition, improvements of the crystal test fixture are reported. A new crystal holder and a temperature-controlled oven have been added. The new holder has been designed to apply a more uniform force to the crystal samples. It is surrounded by a 2 × 2 × 2 in. oven. Four access ports enable force to be applied, both perpendicularly and parallelly, to the light beam. The oven-temperature controller was modified to reduce the temperature variation of the crystal to ±0.15° C. I.v.L.

N64-29519* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
CALIBRATION OF DIATRON-20 RESIDUAL GAS ANALYZER FOR USE IN HIGH VACUUM SYSTEMS
S. V. Caruso 9 Jul. 1962 25 p refs
(NASA-TM-X-51927; MTP-PVE-M-62-11) OTS: $2.60 ph

A method for calibrating a Diatron mass spectrometer is described. The procedure is based on the diffusion of gases through a single polymer membrane (1/32-in.-thick Teflon). The leak standard is first calibrated on an analytical mass spectrometer in CC(STP)/sec for several gases. The apparatus then is used to determine the sensitivity of a Diatron mass spectrometer for the gases. This method provides a single leak rate standard for various gases. The reproducibility of replicate determinations is approximately ±3%, which is within the limits of mass spectrometry techniques. In addition, the combination of the large membrane surface area and mechanism of gas diffusion through a polymer eliminates the problem of frequent plugging of microscopic orifice types of standards. Author

N64-29548* Auto-Control Labs., Inc., Los Angeles, Calif.
HIGH TEMPERATURE THERMOCOUPLE RESEARCH AND DEVELOPMENT PROGRAM Monthly Progress Report, No. 4, 1 Sep.–1 Oct. 1962
R. R. Smith, Jr. 10 Oct. 1963 20 p
(Contract NAS8-5438)
(NASA-CR-58568; T-1097-4) OTS: $1.60 ph

Piece parts for six prototypes have been fabricated. First calibration tests have produced output curves parallel to those previously taken by both NASA and ACL up to 2,200° F. Oxidation effects on one gage over six temperature cycles with a total time of 5 hr were less than anticipated. Literature searches and investigative tests of high-temperature materials were continued. Author

N64-29568* Auto-Control Labs., Inc., Los Angeles, Calif.
HIGH TEMPERATURE THERMOCOUPLE RESEARCH AND DEVELOPMENT PROGRAM Monthly Progress Report No. 11, 1 Apr.–1 May 1964
R. R. Smith, Jr. 10 May 1964 19 p
(Contract NAS8-5438)
(NASA-CR-58569; T-1097-11) OTS: $1.60 ph

This report covers research and development of a high-temperature thermocouple capable of measuring rocket engine exhaust temperature in the 3,000° C range, under adverse conditions of oxidation, erosion, vibration, and shock. Calibrations were continued into the over 4,000° F range. Investigations of high-temperature oxidation-resistant coatings were continued. Materials tests regarding notch sensitivity and ductility of the sheath material were made. Author

N64-29603 Fairchild Camera and Instrument Corp., Syosset, N.Y. Space and Defense Systems Div.
DESIGN AND DEVELOPMENT OF INDICATOR MODULE MOD. 2 AND INTEGRATED MODULAR PROGRAMMER Monthly Progress Report, 1 Dec. 1963–1 Jan. 1964
I. Mc Rae [1964] 5 p
(Contract DA-30-069-AMC-170(A))
(MPR-8; AD-600212) OTS: $1.00

The design, development, and testing of an integrated modular programer (IMP) for Picatinny Arsenal are reported. A design study of an improved Indicator Module Mod. 2 for incorporation in IMP was completed. Besides the Indicator Module, IMP consists of a detached-lever power and rate module and a dual-purpose safety and arming module. M.P.G.

N64-29611 White Sands Missile Range, N. Mex. Inter-Range Instrumentation Group
METHODS FOR ESTIMATING ACCURACY OF POSITION, VELOCITY, AND ACCELERATION DATA
Jun. 1964 49 p refs
(IRIG-103-64; AD-602766) OTS: $3.00

This report is an outgrowth of efforts expended by the Inter-Range Instrumentation Group toward the establishment of an

IRIG standard for techniques to determine the accuracy estimates for instrumentation systems and for the methods of presenting these estimates. The following areas are discussed: (1) definition and discussion of errors—errors in basic quantities; and error types, causes, and characteristics; (2) methods used to estimate random errors—least-squares point estimates, multi-instrument estimate, the variate difference method, and the least-square curve fitting method; (3) methods used to evaluate systematic errors—analytical investigation of possible error sources, comparison of observations from different systems, analysis of measuring residuals from overdetermined least squares solutions, analysis of residuals from a best estimate of trajectory, and velocity and acceleration determination; and (4) the theory of error propagation—propagation of errors into position, error propagation in the same coordinate system, effects of smoothing on data, and inertial guidance data. I.v.L.

N64-29624 Oak Ridge National Lab., Tenn.
LENGTH-MEASURING LASER INTERFEROMETER
H. S. Corey, C. M. Lay, R. W. Schede, and R. E. Sladky 18 Sep. 1964 21 p refs
(Contract W-7405-ENG-26)
(Y-1466) OTS: $0.50

A length-measuring interferometer utilizing a continuous laser light source has been successfully used in connection with an inspection machine. Measurements made on a 10-in. gage block demonstrated a combined accuracy and precision of better than 10μ in. at this distance. Information is also available concerning the method of calculating the precise wavelength of the 6328 A laser emission. The validity was established by the gage block measurements. Author

N64-29644 Massachusetts Inst. of Tech., Cambridge
HIGH-PRECISION PRESSURE SENSOR Quarterly Progress Report No. 14
Lewis G. Anderson, Jean Lavigne, Edward J. Mc Kay, Jr., and Gerald Pollon May 1964 43 p refs
(Contract NOw-61-0400)
(ESL-QR-203; AD-442592)

This report summarizes progress made toward development of a zero to 2,500-psi pressure sensor having an overall precision of 1/4 psi. Present work concerns development of a practical instrument based on a velocity of sound technique whose feasibility was demonstrated in earlier work. The velocity-sensing circuitry is described, and test results are presented to show one part per million stability over periods of 12 to 18 hr. Several methods and instrument configurations for discriminating against the effect of temperature on velocity are described. Constant temperature configurations are analyzed in detail to develop design specifications and performance predictions. Author

N64-29651 Air Force Systems Command, Wright-Patterson AFB, Ohio Systems Engineering Group
MECHANICAL RELIABILITY AND THERMOELECTRICAL STABILITY OF NOBLE-METAL THERMOCOUPLES AT 2600°F TEMPERATURE AND DOSE RATES UP TO 10^{20} NVT
Alfred C. Dallman Apr. 1964 39 p refs Initial Draft of this Report Published as GEMP-183
(SEG-TDR-64-7; GEMP-183; AD-601267)

Reactor tests demonstrated that the following were accomplished: (1) Alumina-flame spray coating of sheath-type noble-metal thermocouples prevented excessive loss of the noble-metal sheath and sensor wire by vaporization and redeposition on cooler surfaces in reactor tests at operating temperatures of 2,500° to 2,600° F; (2) The use of an alumina-coated, noble-metal, bare-wire thermocouple (Span thermocouple) employing a controlled, maximum, feasible separation between sensor wire and/or an alumina-coated thermocouple constructed of two one-conductor coaxial, sheathed thermoelements (Duax thermocouple) insured that temperature information, which will not be affected by significant decalibration, can be obtained for a period of 1,000 hours at a test temperature of 2,600° F. Author

N64-29698* Pittsburgh U., Pa. Graduate School of Public Health
[AUTOMATIC CHROMOSOME ANALYSIS SYSTEM] Quarterly Progress Report No. 4, 1 Apr.–30 Jun. 1964
Niel Wald 17 Aug. 1964 3 p ref
(Contract NASr-169)
(NASA-CR-58533) OTS: $1.10 ph

The current status of the three tasks associated with the automatic chromosome analysis system is reported. These tasks deal with the following: (1) the defining of specifications for the development of the automatic microscope; (2) the digital scanner; and (3) the computer program. Problems considered in task (1) are the electromechanical link, which is involved in moving the microstage along the x, y, and z axis and in automatic slide loading; and logic requirements for mitotic cell identification focus, stage traverse, and mitotic cell size and centering decision. A mechanical flying spot scanner was selected as the type to be used with reference to task (2). Little effort has been expended on task (3), since the assembly of the computer interface is necessary before additional work can be carried to any extent. I.v.L.

N64-29700* Geophysics Corp. of America, Bedford, Mass.
SOLIDS MASS SPECTROMETER Quarterly Technical Progress Report No. 3, 4 May–3 Aug. 1964
[1964] 10 p
(Contract NASw-839)
(NASA-CR-58538) OTS: $1.10 ph

The introduction of a zeolite trap makes it possible to eliminate undesirable noise from the sputter-ion pumps and at the same time to maintain a pressure below 10^{-7} torr in the analyzer section. In order to determine the sensitivity of the instrument for trace impurities, a series of improved spectroscopic standards were devised. Experimental tests have shown that impurity levels in the part per million range can be detected, even under unfavorable conditions. For the determination of statistically varying signals, as might be obtained from samples containing an inhomogeneous concentration of impurities, a digital electronic memory device has shown promising results. Author

N64-29771* Atomics International, Canoga Park, Calif.
THE DESIGN BASIS FOR PIN-HOLE GAMMA-RAY CAMERAS
M. A. Greenfield and R. L. Koontz 15 Sep. 1964 39 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-9924) OTS: $0.75

A theory is presented for the performance of pin-hole gamma-ray cameras in terms of the parameters—sensitivity, resolution, field of view, contrast, magnification, and exposure times. The theoretical expressions for the sensitivity and resolution are shown to be in good agreement with experiment. Several cameras were built of depleted uranium to achieve a desired level of resolution and sensitivity. All the cameras

have been used successfully to examine irradiated fuel pins nondestructively and are capable of demonstrating damage, swelling, and cracking in fuel rods. The resolution of these cameras is of the order of 10 to 20 mils, depending on the average photon energy of the source being viewed. For fission product gamma rays the resolution is approximately 20 mils, and the diameter of the field of view is 4 in. at a distance of 2 ft from the camera's center. Author

N64-29823 Perkin-Elmer Corp., Norwalk, Conn. Electro-Optical Div.
STUDY AND EXPERIMENTAL PROGRAM OPDAR TRAJECTORY MEASUREMENT SYSTEM Final Report
B. Krauss, J. Mc Neill, R. Mc Farlane, H. R. Freeman, R. Rowley et al Griffiss AFB, N.Y., RADC, Jul. 1964 419 p refs
(Contract AF 30(602)-3189)
(Rept.-7534B; RADC-TDR-64-169; AD-604689)

A CW optical radar (OPDAR) for precise early-launch-phase trajectory measurement is described. A single instrument measures slant range, azimuth, and elevation to a small, passive retroreflector mounted on the missile. The data collected are suitable for real-time trajectory evaluation and for postflight computer processing to yield highly precise position, velocity, and acceleration information. Laboratory models of critical components were constructed to demonstrate system feasibility. Models included a shaft angle encoder, a retroreflector, and a model of the range-measurement system. An experiment was conducted to measure the effects of laser noise. Author

N64-29940 Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio
AN AUTOMATIC LOGGING SYSTEM FOR BIOMEDICAL TEST DATA
William J. Hovey (Dayton U.), Jesse E. Gilmore, and Abbot T. Kissen Jun. 1964 17 p
(AMRL-TDR-64-50; AD-604861) OTS: $0.50

An automatic data acquisition system has been designed to minimize the data reduction of biomedical test data. The overall system consists of two main parts—a hardware group, which digitizes and records the raw data, and a computer program, which reduces the data and presents it in tabular form for ready analysis. The system is capable of simultaneously recording up to 27 thermocouple, 27 thermistor, and 24 miscellaneous data channels during any given experiment. The sampling speed is such that it takes approximately 6 seconds to record all 78 channels. Major design considerations were ease of use, utility, flexibility, and reliability. All scale factors and calibrations, both linear and nonlinear, will be effected by the computer program; the recording hardware only digitizes and records voltage levels. Author

N64-29981 Washington U., Seattle
LIQUID FILM HYGROMETRY Scientific Report No. 2
Robert J. Charlson and K. J. K. Buettner May 1964 109 p refs
(Contract AF 19(628)-303)
(AFCRL-64-493; AD-604340)

Based on a need for a hysteresis-free and theoretically predictable hygrometer, the studies are concerned with the development of a liquid phase absorption hygrometer. This instrument, which senses the partial pressure of water vapor of a sample gas flow, utilizes a heterogeneous mixture of a hygroscopic liquid coated on the surface of an inert granular solid as the dielectric of a capacitor. A theoretical analysis of the response of this instrument based on Raoult's law and the Clausius–Mosotti equation is made, and an experimental demonstration of the applicability of this theory is presented. Other parts of the theoretical treatment include an analysis of the time response, the temperature dependence, and the effects of changes in dielectric composition. Author

N64-30010 Library of Congress, Washington, D.C. Aerospace Technology Div.
TIME SERVICE IN THE USSR Special Report
5 Aug. 1964 19 p refs Transl. into ENGLISH from Various RUSSIAN Sources
(ATD-P-64-48; AD-603696) OTS: $1.60 ph

General information regarding the subject of standard-time-signal transmission in the Soviet Union is presented. Included is information on the departments in charge of time keeping, instruments used for astronomical time determination, standard-frequency services, and a list of radio stations transmitting standard time and frequency signals. P.V.E.

N64-30017 Wisconsin U., Madison Geophysical and Polar Research Center
THE ELSEC WISCONSIN DIGITAL RECORDING PROTON PRECESSION MAGNETOMETER SYSTEM
Richard J. Wold Jun. 1964 91 p refs
(RR-64-4)

The design and construction of a digital recording proton precession magnetometer system is described. The primary data output is punched tape, which is easy to handle and can be fed directly into a computer. Samples of the various data outputs, the computer programs used for decoding the punched tapes, and all schematics and photographs of the system are presented. Author

N64-30020 Bendix Corp., Ann Arbor, Mich. Bendix Systems Div.
THE CANADIAN ARMAMENT RESEARCH AND DEVELOPMENT ESTABLISHMENT (CARDE) SUPPORT PROGRAM Semiannual Report, 1 Jan.–30 Jun. 1964
J. Rutkowski [1964] 48 p
(Contract DA-20-018-ORD-23307; ARPA Order-133; Proj. Defender)
(BSR-984; AD-443381)

This report includes both a narrative and a pictorial review of the program and projects undertaken in connection with the Canadian Armament Research and Development Establishment (CARDE) Support Program, among which are these: instrumentation (general, standard, and scientific), test programs, facility status, and cone launch development program. A.W.

N64-30026 Illinois U., Urbana Electrical Engineering Research Lab.
THE UNIVERSITY OF ILLINOIS RADIO TELESCOPE Progress Report, 1 Apr.–30 Jun. 1964
G. C. Mc Vittie and G. W. Swenson, Jr. 10 Jul. 1964 7 p
(Contract Nonr-1834(22))
(PR-20; AD-602518)

The radio telescope was in operation during the entire report period. An additional tuning-fork-controlled sidereal clock has been constructed and placed in operation, preparatory to the installation of digital recording equipment. A computer program was written to determine the right ascension, declination, and flux density of observed radio sources. Observation of Jupiter on June 16 yielded a maximum antenna temperature of 0.612° K, corresponding to a flux density of 3.40×10^{-26} units. Normalized to a distance of 4.04 au, the flux density is 6.35 x

10^{-26} units. Observations of Cas A and Cyg A were made to determine the side lobe structure in the right ascension coordinate. P.V.E.

N64-30055 Daystrom, Inc., Newark, N.J.
DIGITAL DISPLAY AERIAL SURVEY METER **Final Report**
Jun. 1964 39 p
(Contract OCD-PS-64-10)
(OCD-2131-F; AD-602462) OTS: $2.00

Three digital display indicators have been incorporated into the CD V-781 aerial survey meter replacing the three conventional panel meters to display dose rate readings numerically. The digital display indicator contains a D'Arsonval mechanism and an optical system arranged to provide a projected image on a screen. Readability error is virtually eliminated, since only one indicator is visable at a time, displaying a discrete reading of dose rate. Each digital display indicator provides 10 distinct values in a two-figure display measuring 3/4 in. high by 1/4 in. wide. Author

N64-30056 Weizmann Inst. of Science, Rehovoth (Israel)
AN INEXPENSIVE AUTOMATIC RECORDING MOSSBAUER SPECTROMETER
J. Lipkin, B. Schechter, S. Shtrikman, and D. Treves 25 Feb. 1964 21 p refs
(Contract AF 61(052)-654)
(TN-4; AD-602464)

An automatic recording constant velocity Mössbauer spectrometer for Fe^{57} is described. The motor and the velocity sensor are integrated in a specially designed electromechanical unit. Feedback is used to make the velocity proportional to an input voltage. Recorded line widths only 25% larger than the natural width are obtained. Author

N64-30064* Radio Corp. of America, Princeton, N.J. RCA Labs.
ASTRONOMICAL IMAGE-INTEGRATION SYSTEM USING A TELEVISION CAMERA TUBE
E. Luedicke, A. D. Cope, and L. E. Flory Repr. from Appl. Opt., v. 3, no. 6, Jun. 1964 p 677–689 refs
(Grants NsG-69-60; NSF G-14905 Contract Nonr-1858-03)

An image orthicon camera operated according to the cycle described in this paper appears capable of extending the astronomer's limit of detection 3 to 4 stellar magnitudes lower than can be obtained with 103aO film in the same exposure interval. When operating a tube with an S20 photocathode and a metal-oxide storage target at –20° C, it has been possible to continue to integrate a low-level input for as long as 3 hr. Various anomalies related to this type operation with point images have been observed. The causes and means for overcoming them are discussed. Author

N64-30090* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE TIROS LOW RESOLUTION RADIOMETER
Frank Bartko, Virgil Kunde, Clarence Catoe, and Musa Halev Washington, NASA, Sep. 1964 40 p refs
(NASA-TN-D-614) OTS: $1.00

The Tiros II, III, and IV (1960 π1, 1961 ρ1 and 1962 β1) meteorological satellite experiments included a low resolution infrared radiometer of broad spectral and spatial response designed to measure the planetary heat budget of the earth. This paper presents the physical and optical characteristics of the radiometer, the calibration, and the procedure for determining the coefficients of the energy balance equations from the calibration data. The procedure for reducing the data is discussed, and an error analysis of the radiation data from a Tiros III orbit is presented. Efforts to improve the performance of the low-resolution radiometer and a summary of the status of the low-resolution-radiometer program are also presented. Author

N64-30116 Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
A STUDY OF IMAGE QUALITY EVALUATION **Final Report**
Melvin J. Mazurowski, Harry B. Hammill, and George H. Snider Griffiss AFB, N.Y. RADC, Aug. 1964 82 p refs
(Contract AF 30(602)-3206)
(CAL-VE-1867-G-1; RADC-TDR-63-536; AD-605184)

The derivation of an approximate summary measure, which would relate measurable photographic parameters to judgments of target interpretability, was investigated. An alternative technique for the visual ordering of photographs according to image quality was also studied. Precise and approximate analysis techniques of microdensitometer data for obtaining measures of photographic quality parameters were developed for black and white photography and a brief investigation of the extension of these techniques to color images was conducted. Image quality parameter evaluation techniques are documented, and some preliminary attempts to derive summary measure functions are discussed. Author

N64-30127 Bettis Atomic Power Lab., Pittsburgh, Pa.
EXPERIMENTAL AND ANALYTIC STUDIES OF ELECTRO-MECHANICAL TRANSDUCER SYSTEMS FOR TRANSIENT PRESSURE MEASUREMENTS
T. W. Hunt Aug. 1964 56 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-343)

Six electromechanical pressure transducer systems consisting of variable reluctance transducers, tubing, valves, and fittings with water as the pressure transmitting fluid were designed, built, and tested. The systems were used to measure transient pressure drops caused by transient flow conditions in thermal and hydraulic experiments, which simulate nuclear heating of pressurized water reactors through electrical heating of test sections. The frequency response and damping factor measurements for 21 combinations of transducer rating and system design are tabulated. The effect upon response and damping of various sizes of orifices is also tabulated. Author

N64-30131 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
POLAROGRAPH LP-55
30 Jul. 1963 4 p Transl. into ENGLISH from Lab. Pristroje (Praha), no. F-422
(FTD-TT-63-693/1; AD-602550)

The LP-55 polarograph is described. It uses the classic photographic method for automatic plotting of photographic curves, and has a voltage accuracy of 1.5 mv and a current accuracy of better than 1. The polarograph consists of the following structurally independent parts: the instrument itself, the galvonometer, and the projection tube. Except for the latter two, all individual elements of the device are built on a common chassis and placed in a metal housing. A.W.

N64-30160 Airtechnology Corp., Cambridge, Mass.
NON-CHOPPING RIOMETER WITH CW AND PULSE INTERFERENCE–REJECTION CIRCUITRY First Summary Technical Report, 18 Mar.–3 Jul. 1963
J. Maxwell Aug. 1963 19 p
(Contract AF 33(657)-12075)
(Rept.-191-1; AD-415271)

Breadboard versions of the following components to be used with the Mode III riometer indicate that the objectives of Task I have been accomplished successfully. These are as follows: (1) a diode clipping device to eliminate pulse interference; and (2) a frequency diversity device using two frequencies in the passband to eliminate cw interference. These circuits can, with some modifications, be incorporated into the Task II prototype Mode III riometer and will provide the desired interference rejection capability. M.P.G.

N64-30178 Sylvania Electric Products, Inc., Waltham, Mass. Sylvania Electronics Systems
RADAR INTERFERENCE STUDY Final Report
Walter B. Mills and Joseph F. Clark Bedford, Mass., Electron. Systems Div., May 1964 114 p
(Contract AF 19(604)-8484)
(ESD-TDR-64-252; AD-602709) OTS: $4.00

Discussed is the activity carried on for the Air Force to establish the radar signatures of interfering targets, such as weather, angels, and other unknowns. A summary of the data gathered is given, as well as descriptions of two circuits developed to combat the interference. Performance of these circuits when applied to an AN/FPS-8 radar is described and documented. Author

N64-30180 Naval Research Lab., Washington, D.C.
DOSIMETERS OF IONIZING RADIATION BASED ON THE MEASUREMENT OF THERMOLUMINESCENCE OF ALUMOPHOSPHATE GLASSES ("IKS" DOSIMETERS) [DOZIMETRY IONIZIRUYUSHCHIKH IZLUCHENIY, OSNOVANNYE NA IZMERENII TERMOLYUMINESTSENTSII ALYUMOFOSFATNYKH STEKOL (DOZIMETRY "IKS")]
I. A. Bochvar, A. A. Vasil'eva, I. B. Keirim-Markus, T. I. Prosina, Z. M. Syritskaya et al 1964 16 p refs Transl. into ENGLISH from Atomnaya Energiya (Moscow), v. 15, No. 1, 1963 p 48–52
(NRL-TRANS-972; AD-600493) OTS: $1.00

A description is given of thermoluminescent dosimeters made of alumophosphate glasses. The method is based on the fact that the energy of ionizing radiation absorbed by the glass is stored within it in the form of the luminescent light sum, which is emitted while the glass is being heated and therefore can be recorded. A.W.

N64-30186 Utah U., Salt Lake City Utah State U., Logan
AEROSPACE VEHICLE DETECTION STUDIES Technical Documentary Report, 1 Mar.–31 May 1964
Obed C. Haycock 18 Jun. 1964 38 p refs
(Contract AF 04(695)-339)
(AD-602812) OTS: $2.00

Factors are considered that influence the sensitivity of a scanning Fabry–Perot interferometer when used as a detector, and an estimate is made of the expectable sensitivity of the detector. A design was chosen for a field spectrograph, and materials were procured. The problem of ion recombination on the surface of a satellite is approached by analyzing the vehicle potentials of orbiting satellites. D.E.W.

N64-30193 Army Chemical Center, Edgewood, Md. Nuclear Defense Lab.
GLASS MICRODOSIMETRY SYSTEM USED AT THE U. S. ARMY NUCLEAR DEFENSE LABORATORY
Edward E. Lissak and Robert J. Smith May 1964 29 p refs
(NDL-SP-6; AD-443879)

The silver-activated phosphate-glass microdosimeter system is explained. The advantages and disadvantages of the system, as well as the idiosyncracies of the microdosimeters themselves, are reported. It is concluded that this system provides an efficient and reliable method of determining gamma dose in the range from 10 to 4 × 10^5 rads. Author

N64-30200 General Dynamics/Astronautics, San Diego, Calif.
RESEARCH DIRECTED TOWARD DEVELOPMENT OF A PROTOTYPE LUNAR TRANSPONDER (INCLUDING A FEASIBILITY STUDY ON THE CONFIGURATION OF FOUR EARTH-BASED TRACKING STATIONS, VOLUME I Final Report
F. W. Shaw 15 Sep. 1963 131 p
(Contract AF 19(628)-1609)
(GD/A-63-0933; AFCRL-63-765; AD-603271)

This report covers the results of a tracking feasibility study, a lunar transponder design study and prototype fabrication, and a lunar impact-point marker study. During the tracking study both one and four station global configurations were considered, utilizing basic GLOTRAC ground stations with modifications. Atmospheric effects were considered and numerical analysis was undertaken to determine ultimate system accuracies. The transponder study included electronic circuit design, advanced microwave techniques, and special packaging techniques. The impact marker study investigated both passive and active techniques. Author

N64-30204 Stanford Research Inst., Menlo Park, Calif.
DESIGN OF PRESSURE TRANSDUCERS, PROJECT COACH Final Report
D. D. Keough 20 May 1964 10 p refs
(Contract DA-49-146-XZ-273; ARPA Order-172-61)
(AD-442689)

The piezoresistance gage initially permitted recording of pressure profiles of 10- to 150-kbar peak gage pressure, and the insulator was reasonably matched to the shock impedance of desert surface. At the time of cancellation of Project Coach, work had been initiated to design, construct, and test gages matched to the shock impedance and, if possible, to the Hugoniot of salt. Matching the shock impedance proved quite feasible, and work was begun on matching the Hugoniot of salt. Matching procedures and materials are listed. D.E.W.

16 LIFE SCIENCES

Includes biology; exobiology; physiology; medicine; life support systems; radiation effects on biological systems; and space sickness. *For related information see*: 14 Human Behavior; and 28 Space Radiation.

N64-29032 Joint Publications Research Service, Washington, D.C.
STUDIES IN SELF-PURIFICATION OF CESIUM-137 FROM RESERVOIR WATER AND IN SOME SPECIES OF ALGAE

21 Aug. 1964 35 p refs Transl into ENGLISH from Byul. Mosk. Obshchestva Ispytatelei Prirody, Otd. Biol. (Moscow), v. 69, no. 3, May–Jun. 1964 p 20–24, 110–126 (JPRS-26056; TT-64-41326) OTS: $2.00

CONTENTS:

1. SELF-PURIFICATION OF CESIUM-137 FROM WATER IN WEAKLY RUNNING RESERVOIRS AT VARIOUS SPEEDS OF FLOW, VOLUMES OF WATER, AND CONCENTRATIONS OF CESIUM A. L. Agre, I. V. Molchanova, and N. V.Timofeyev-Resovskiy p 1–8 refs (See N64-29033 21-16)

2. BIOCHEMICAL INVESTIGATION OF SOME ALGAE SPECIES M. V. Pakhomova p 9–27 refs (See N64-29034 21-16)

N64-29033 Joint Publications Research Service, Washington, D.C.

SELF-PURIFICATION OF CESIUM-137 FROM WATER IN WEAKLY RUNNING RESERVOIRS AT VARIOUS SPEEDS OF FLOW, VOLUMES OF WATER, AND CONCENTRATIONS OF CESIUM

A. L. Agre, I. V. Molchanova, and N. V. Timofeyev-Resovskiy *In its* Studies in Self-Purification of Cesium-137 from Reservoir Water and in Some Species of Algae 21 Aug. 1964 p 1–8 refs (See N64-29032 21-16) OTS: $2.00

Data are presented from experiments on the biological purification of water (cesium^{137} removal) and the distribution of cesium among the components of water reservoirs (water, earth, biomass) as a function of hydrodynamic factors, namely, the speed of water flow, dilution, and the concentration of cesium in the water. It is indicated that the greatest cleansing effect is achieved in the case where a concentrated cesium solution is fed into the system; the flow speed is low; and the volume of water passing through the system is small (dilution factor). I.v.L.

N64-29034 Joint Publications Research Service, Washington, D.C.

BIOCHEMICAL INVESTIGATION OF SOME ALGAE SPECIES

M. V. Pakhomova *In its* Studies in Self-Purification of Cesium-137 from Reservoir Water and in Some Species of Algae 21 Aug. 1964 p 9–27 refs (See N64-29032 21-16) OTS: $2.00

A study was made of the total chemical composition of 20 algae. The greatest amount of total nitrogen, protein, and nucleic acids is contained in unicellular green, blue-green, and euglenoid algae. Diatomaceous algae are characterized by a high content of "crude fat." The bulk of the organic substance in large green and brown algae is in the form of carbohydrates. The composition of the proteins, amino acids, and carbohydrates of certain of these algae was also studied. I.v.L.

N64-29073 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

HUNGARIAN RADIOLOGY Selected Articles

28 May 1964 32 p Transl. into ENGLISH from Magyar Radiol. (Hungary), v. 5, no. 4, 1963 p 193–200, 208–214 (FTD-TT-64-163/1+3+4; AD-442436)

CONTENTS:

1. BIOLOGICAL-CHEMICAL PROTECTION FROM RADIATION F. Toth p 1–15 (See N64-29074 21-16)

2. PRACTICAL ORGANIZATION OF RADIATION PROTECTION J. Barany p 16–34 (See N64-29075 21-16)

N64-29074 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

BIOLOGICAL-CHEMICAL PROTECTION FROM RADIATION

Ferenc Toth *In its* Hung. Radiol. 28 May 1964 p 1–15 (See N64-29073 21-16)

The use of ionizing radiation has made it necessary to study radioprotective measures. This paper presents a brief survey of the more important groups of radioprotective chemicals and also deals with the problem of the effect mechanism of such radioprotective substances. It also touches on problems involved in the use of the marrow transfusion. Author

N64-29075 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

PRACTICAL ORGANIZATION OF RADIATION PROTECTION

Janos Barany *In its* Hung. Radiol. 28 May 1964 p 16–34 (See N64-29073 21-16)

The basic principle of radiation protection can be defined quite simply: people should not be exposed to unnecessary radiation effects. This report surveys the possibilities presented by various practical solutions. Since informative work and persuasive techniques have produced almost no results in furthering radioprotection, it is clear that this protection can be realized effectively only through action by governmental authorities. Their main objective should be to see to it that X-raying is performed only after the results of all other clinical tests are in, and only when indicated by them, except for cases of immediate lethal danger. Unwarranted X-raying should be taken as a cause for disciplinary action. Should this method of control prove inadequate, it would seem appropriate to set up a control department within the framework of the National Radioprotection Institute, which would make on-the-spot investigations of X-ray practices. Courses on radioprotection should be set up for radiologists, and consulting physicians should be given refresher courses. In addition, reeducation of workers with radiation (technicians, etc.) should be required. I.v.L.

N64-29090 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

THE REACTION OF THE CARDIOVASCULAR SYSTEM OF MAN AND ANIMALS UNDER WEIGHTLESS CONDITIONS

R. M. Bayevskiy and O. G. Gazenko *In its* Cosmic Res., v. 2, no. 2 8 Jun. 1964 p 212–232 refs (See N64-29076 21-01)

Material is presented on the study of the cardiovascular system, conducted on the second and third spaceships and on the Vostok ships. The phasic nature of the reaction of the blood circulation system is established. It is shown that shifts of the functional condition of the heart and vessels can be caused by a decrease in the organism's demands on the cardiovascular system under weightless conditions and by changes in nerve regulation. Data affirm a decrease in the myocardial work level and an increase in asynchronism in the activity of the right and left heart. It is concluded that the tonus of the parasympathetic nervous system is enhanced under weightlessness. Questions about the value of studying blood circulation for insuring space flight safety are discussed. Author

N64-29091 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

THE EFFECT OF SPACE FLIGHT FACTORS ON MICROSPORES OF *TRADESCANTIA PALUDOSA* ON BOARD VOSTOK 5 AND VOSTOK 6

N. L. Delone, V. F. Bykovskiy, V. V. Antipov, G. P. Parfenov, V. G. Vysotskiy et al *In its* Cosmic Res., v. 2, no. 2 8 Jun. 1964 p 233–251 ref (See N64-29076 21-01)

To differentiate the effect of the dynamic flight factors from those of weightlessness and cosmic radiation on the hereditary structures of *Tradescantia paludosa*, cosmonaut V. F. Bykovskiy fixed the test material 1.5, 76, and 120 hr after launch. Analysis of the experimental data showed that three types of changes arose in *Tradescantia* microspores as a result of the flight—chromosomal aberrations, destruction of the mitotic mechanism, and stimulation of cell growth processes. A hypothesis is proposed that chromosomal aberrations result from the dynamic factors and that destruction of the mitotic mechanism is due mainly to the effect of weightlessness. Author

N64-29092 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
GROWTH OF ORGANISMS UNDER WEIGHTLESSNESS
G. P. Parfenov *In its* Cosmic Res., v. 2, no. 2 8 Jun. 1964 p 252–260 refs (See N64-29076 21-01)

This report describes the methods and results of the first test on impregnation, reproduction, and development of *Drosophila* under conditions of weightlessness. Data are presented on the density of experimental cultures, ratio of sexes, presence of morphosis in individuals that had developed under conditions of weightlessness, and on the frequency of recessive lethals in their gametes. It is demonstrated that for certain organisms the condition of weightlessness does not present a substantial obstacle to impregnation and embryonic development. Author

N64-29093 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE CAUSES OF GERM CELL MORTALITY IN DROSOPHILA AFTER FLIGHTS ON VOSTOK 3 AND 4
G. P. Parfenov *In its* Cosmic Res., v. 2, no. 2 8 Jun. 1964 p 261–271 refs (See N64-29076 21-01)

In addition to new data on dominant lethal mutations in males, this report contains information on the frequency of this type of mutation in females. The frequency of dominant lethals does not increase in male gametes. The slight increase in egg deaths in the test groups is explained by the less energetic sexual behavior of the males after space flight. The observed increase of dominant lethals in female gametes does not have the character of a radiation effect. Author

N64-29194* Republic Aviation Corp., Farmingdale, N.Y. Space Environment and Life Sciences Lab.
STUDY OF THE NORMAL FECAL BACTERIAL FLORA OF MAN Quarterly Progress Report, Apr. 1–Jun. 30, 1964
Lorraine S. Gall [1964] 7 p
(Contract NASw-738)
(NASA-CR-58287; RAC-931-4) OTS: $1.10 ph

The physiology of many of the predominating type of cultures isolated from the feces of adult male subjects is being studied. The carbohydrate fermentation of the feces was studied, with a particular attention being paid to lactic acid production, manometric estimation of metabolic end products, and isolation of predominating fecal bacteria. P.V.E.

N64-29202* Esso Research and Engineering Co., Linden, N.J.
DEVELOPMENT OF HYDROCARBON ANALYSES AS A MEANS OF DETECTING LIFE IN SPACE Quarterly Report
W. G. Meinschein 1 Jul. 1964 24 p refs
(Contract NASw-508)
(NASA-CR-58500) OTS: $2.60 ph

Irradiation of solid methane with γ-rays yields liquid alkanes that have lower mean molecular weights, less structural order, and smaller n-paraffin contents than biological or sedimental alkanes. Bacteria and kelp contain hydrocarbons that are chromatographically equivalent to 2,6,10-trimethylpentadecane, pristane, phytane, and 2,6,10,14-tetramethylheptadecane. Benzene extracts of a 2.5 billion-year-old Sudan sediment are rich in free sulfur and alkanes. Distributions of alkanes in the wash and extracts of the Sudan rock indicate an indigenous origin and a natural fractionation of these compounds. Pristane and phytane are apparently present in high concentrations in the hydrocarbons from the Sudan chert and Murray meteorite. Author

N64-29278 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
STUDY OF THE TENSION OF OXYGEN IN THE TISSUE OF THE LIVE BRAIN DURING EXTENDED ACCELERATION
Ye. A. Kovalenko, V. L. Popkov, and I. N. Chernyakov 3 Sep. 1963 10 p refs Transl. into ENGLISH from Byull. Eksperim. Biol. i Med. (Moscow), No. 1, 1963 p 43–47
(FTD-TT-63-848/1+2; AD-420759)

Polarographic determinations of oxygen tension were made, with the aid of platinum electrodes implanted in the brain tissues of a dog, for the study of hypoxia. Overloads were caused by whirling the animals, on a centrifuge, in different directions. The time of action of the overload amounted to 1 minute; the intensity of the overload was from 2 to 12 g. Altogether, 156 turns were made on the dogs. The action of the overload in the head-to-pelvis, pelvis-to-head, and spine-to-breast directions was studied. The most pronounced changes in oxygen tension were observed during the action of the overloads in the directions of head-to-pelvis; second in line was the pelvis-to-head. Very little change, comparatively speaking, was noted in the oxygen tension in the case of transverse loads (spine-to-breast). This decrease in oxygen tension with all kinds of overloads, and especially in the case of overloads in the direction head-to-pelvis, indicates that oxygen starvation is one of the basic factors in the pathogenesis of breakdowns brought about by accelerations. These breakdowns pertain, particularly, to disorders of hemodynamics and respiration. I.v.L.

N64-29286 School of Aerospace Medicine, Brooks AFB, Tex. Aerospace Medical Div.
BASELINE VALUES FOR AN INTRAMUSCULAR ACTH TEST BASED ON PAROTID FLUID FREE 17-HYDROXYCORTICOSTEROID LEVELS
Ira L. Shannon, John R. Prigmore, and Steven C. Beering Jul. 1964 8 p refs
(SAM-TDR-64-37; AD-446149)

In 206 healthy young adult males, the intramuscular administration of 40 units ACTH-gel produced significant increases in parotid fluid 17-hydroxycorticosteroid levels 1 and 2 hours after dosage. Assay of the parotid fluid steroid is presented as a nonstress screening procedure in evaluating adrenocortical function. These data are offered as physiologic baselines for comparison in suspected adrenal disorders. Author

N64-29287 School of Aerospace Medicine, Brooks AFB, Tex.
POLAROGRAPHIC DETERMINATION OF OXYGEN CONTENT AND CAPACITY IN A SINGLE BLOOD SAMPLE
Domenic A. Maio and James R. Neville Jul. 1964 12 p refs
(SAM-TDR-64-39; AD-446150)

A technique for polarographically determining oxygen content of blood was described in an earlier report. The results obtained by using this method compare favorably with those obtained by using the Van Slyke technique. Moreover, the method permits the accurate, rapid determination of oxygen content in small samples of blood. As with the Van Slyke technique, total oxygen capacity was formerly estimated by a separate determination of the oxygen content after complete saturation with oxygen of another portion of the blood sample. Further experience with the method has revealed the feasibility of estimating both content and capacity in a single blood sample. The capacity estimate is made possible by the polarographic observation of the quantity of potassium ferricyanide required to convert ferrohemoglobin to ferrihemoglobin. The measurement of oxygen content is performed by the polarographically determined increase in physically dissolved oxygen caused by the release of bound oxygen. By this means, sampling and random errors inherent in the use of two separate determinations are avoided. The method requires only a brief time for performance and ordinary technical proficiency. It is also exceedingly simple in application. Author

N64-29288 School of Aerospace Medicine, Brooks AFB, Tex. Aerospace Medical Div.

CEREBRAL ARTERIOVENOUS DIFFERENCES IN METABOLIC SUBSTRATES DURING HYPERTHERMIA

Harry M. Frankel and Stephen M. Cain Aug. 1964 12 p refs

(Contract AF 41(609)-1499)

(SAM-TDR-64-44; AD-446151)

The effect of a progressive increase in rectal temperature on arterial and cerebral sagittal sinus blood lactate, pyruvate, glucose, and bicarbonate concentrations, as well as on pH, PCO_2, Po_2, and hemoglobin saturation (% Hb sat) were studied in 8 dogs. There was no consistent pattern of increase in calculated cerebral excess lactate (XL) at temperatures lower than that at which arterial XL was reported to appear in the blood. Minimum cerebral sagittal sinus P_{o2} and % Hb observed were 35-mm Hg and 35%, respectively. The conclusion was made that the brain did not become hypoxic before the other tissues of the body. Author

N64-29339* National Aeronautics and Space Administration, Washington, D.C.

SPACE MEDICINE: SCOPE, PROGRESS AND APPLICABILITY TO OTHER MEDICAL FIELDS

S. P. Vinograd Repr. from Postgraduate Med., v. 36, no. 2, Aug. 1964 p 95–102 refs

(NASA-RP-306)

Space medicine concerns itself with normal man in an abnormal environment. Its contributions to medical science include information about radiation; increased knowledge of physiologic responses, and improved bioinstrumentation and analysis and data storage techniques. Bioinstrumentation may be the key to earlier diagnosis of many pathologic conditions. A brief review is given of problems peculiar to space medicine, and a summary is made of its progress as a national program. A.W.

N64-29538* Massachusetts Inst. of Tech., Cambridge Research Lab. of Electronics

A THEORY OF PASSIVE ION FLUX THROUGH AXON MEMBRANES

J. Y. Lettvin, W. F. Pickard, W. S. Mc Culloch, and W. Pitts Repr. from Nature (London), v. 202, no. 4939, 27 Jun. 1964 p 1338–1339 refs

(Grants NsG-496; NIH MH-04737-03; NSF G-16526; Contracts DA-36-039-AMC-03200(E); AF 33(616)-7783)

A lock-and-key model is proposed to explain passive ion flux through the membranes of unmyelinated nerve axons. Among the assumptions made are these: (1) Mass transport across the living axon membrane is by way of the small channels or pores in the bimolecular leaflet membrane. (2) Anions and cations pass through different channels. The cation channels are of two types—a potassium channel that is large enough to pass hydrated K^+ but not hydrated Ca^{++}, and a sodium–calcium channel that is large enough to pass hydrated Ca^{++} with difficulty and hydrated K^+ and Na^+ with ease. (3) A hydrated ion is able to lock a channel either by covering one end and electrostatically binding there or by entering a channel and binding electrostatically to its walls. (4) An ion is able to function as a key for a locked channel by tumbling the locking ion out of the channel and replacing it as the channel lock. (5) Each variety of hydrated ion will be unique in its ability to lock and unlock the channel because of its unique electrical and steric properties. Predictions as to how the given ions will act are made, and it is suggested, on the basis of this model, that La^{+++} should function as a nerve-blocking agent. The suggestion is also made that the efficacy of many local pain killers may be due to a superficially similar blocking action on ion fluxes. M.P.G.

N64-29546* Allied Research Associates, Inc., Concord, Mass.

A REVIEW OF BIOLOGICAL MECHANISMS FOR APPLICATION TO INSTRUMENT DESIGN Second Summary Report

J. Healer, H. Homonoff, C. Jamieson, D. Kimura, S. Koslov et al Dec. 1963 315 p refs

(Contracts NASr-16; NASw-535)

(NASA-CR-58560; ARA-T-9211-5, Vol. 1)

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N64-29557* Ling-Temco-Vought, Inc., Dallas, Tex. Astronautics Div.
A PRELIMINARY DESIGN GUIDE OF HUMAN ENGINEERING CRITERIA FOR MAINTENANCE AND REPAIR OF ADVANCED SPACE SYSTEMS (HECMAR)
R. D. Huchingson and R. C. James, Jr. 19 Jun. 1964 311 p refs
(Contract NAS9-1670)
(NASA-CR-58575; Rept.-00.474) OTS: $19.75 ph

Among the products of this phase of study was the development of a preliminary design guide based upon those existing design criteria that may have applicability to the space environment, to intravehicular and extravehicular maintenance, and to currently conceived space vehicles. Emphasis was placed on detail design factors and criteria and on those human aspects that are most likely to be modified by man's experience and performance in a pressure suit. The most likely factors to be modified by suit condition are body dimensions, mobility, reach capabilities, force capabilities, speed of response, and psychomotor skills. The area of sensory capabilities was limited to visual problems in space, noise protection, and speech intelligibility in a noise field. In bioastronautics, emphasis was placed upon the behavioral implications of environmental parameters rather than upon physiological limits and tolerances. Force capabilities under weightlessness were considered. This preliminary design guide presents the design criteria in the form of requirements and prohibitions rather than in statements of principle. I.v.L.

N64-29559* IIT Research Inst., Chicago, Ill. Life Sciences Div.
SURVIVAL OF MICROORGANISMS IN A SIMULATED MARTIAN ENVIRONMENT. I: *BACILLUS SUBTILIS* VAR. *GLOBIGII*
C. A. Hagen, E. J. Hawrylewicz, and R. Ehrlich Repr. from Appl. Microbiol., v. 12, no. 3, May 1964 p 215–218 refs
(Contract NASr-22)

Survival of *Bacillus subtilis* var. *globigii* in a simulated Martian environment was demonstrated. Previous contact with the simulated Martian soil or atmosphere reduced germination or outgrowth of unheated spores, or both. Inoculation into simulated Martian soil and then flushing with a simulated Martian atmosphere were lethal to both vegetative cells and spores. After one diurnal temperature cycle (26° to −60° C), the majority of cells present were spores. No further effect of the diurnal cycle on survival was noted in any of the experimental samples Author

N64-29573* Avco Corp., Tulsa, Okla.
STUDY OF THE CORRELATION BETWEEN LINEAR ENERGY TRANSFER AND RELATIVE BIOLOGICAL EFFECTIVENESS Final Report, Jul. 1963–Aug. 1964
K. M. Hoalst et al [1964] 70 p refs
(Contract NASw-782)
(NASA-CR-58289) OTS: $6.60 ph

The instruments developed for this program include small tissue equivalent proportional counters for measuring LET spectra over a wide range of radiation intensities and tissue equivalent ionization chambers for the direct measurement of radiation absorbed dose in tissue. In the biological system development, living tissue was simulated by compacting haploid yeast cells (strain Sc-7) in solid polyethylene glycol. The compacted mass of cells was irradiated, and serial sections were taken to assay radiation damage at various depths. The ability of the irradiated cells to produce a macroscopic colony on suitable nutrient material was a measure of cell survival. Radiation exposures were made with 22.3 Mev and 210 Mev protons, and the results were compared with 200 KVCP X-ray irradiation results. Author

N64-29583 Naval School of Aviation Medicine, Pensacola, Fla.
THE EFFECT OF VIBRATION AND RESTRAINT ON BODY WEIGHT AND SURVIVAL OF THE ALBINO RAT
Donald E. Furry 19 Sep. 1963 10 p refs
(Rept.-5; AD-426475)

The effects of whole body vibration at a constant frequency (25 cps) and displacement (0.25 in.) were studied using male Sprague–Dawley rats. Primary emphasis was placed on the determination of lethal exposure time. In addition, the effect of restraint, variation in body weight, and determination of a nonlethal stress condition were evaluated. The mean survival time of restrained animals was 116 minutes, with the major gross pathological finding being pulmonary hemorrhage. Incidental findings included gastrointestinal and myocardial hemorrhage in the animals exposed to a lethal vibration stress. Mean net body weight loss was calculated for restrained animals vibrated only 30 minutes as 1.7 grams as compared to 0.2 gram in a group of nonvibrated animals restrained for 30 minutes. Nonfatal vibration stress of 6-hours' duration applied to nonrestrained rats resulted in a mean net body weight loss of 21.4 grams. Author

N64-29594 Massachusetts Inst. of Tech., Cambridge
EVOKED RESPONSES FROM THE AUDITORY CORTEX
Donald C. Teas and Nelson Y-s Kiang (Mass. Eye and Ear Infirmary) Repr. from Exptl. Neurol., v. 10, no. 2, Aug. 1964 29 p refs
(Grants NsG-496; NSF G-16526; NIH MH-04737-03; NIH G-B-1344)

Evoked responses were recorded from the auditory cortex of unanesthetized cats. With clicks of moderate intensity, the waveforms of the responses were highly repeatable among awake cats. Introduction of certain variables, such as localized injury to cortex, anesthesia, or sleep, resulted in more or less characteristic changes in the waveform of the evoked responses. In particular, the later components of the responses seemed to be more sensitive to changes in the state of the animal, while the early components seemed to be abolished by local injury to the cortex. The evoked responses and particularly the later components did not always behave in a reliably repeatable fashion as click intensity or click rate was changed. Author

N64-29663* Detroit U., Mich.
PORPHINE-LIKE SUBSTANCES: PROBABLE SYNTHESIS DURING CHEMICAL EVOLUTION
Anton Szutka Repr. from Nature, v. 202, no. 4938, 20 Jun. 1964 p 1231–1232
(Grant NsG-226)

Experiments were conducted wherein an aqueous suspension of pyrrole and benzaldehyde was irradiated at room temperature with either ultraviolet or visible light. In addition, an aqueous suspension and a solution in pyridine of pyrrole and benzaldehyde were placed in semidarkness without irradiation. In all cases a porphine-like product, that is, $\alpha,\beta,\gamma,\delta$-tetraphenylporphine was obtained. Results of these experiments indicate that the presence of water, or rather the suspension of the organic matter in water, increased the yield of porphine-like substances considerably. The increase observed in the yield of porphine-like substances, on standing, show that a process of autocatalysis takes place. In addition, evolutionary selection pressure was exerted for the synthesis of porphine-like substances as soon as the reductive atmosphere was converted into an oxidative one. Simultaneously, with the change of a reductive atmosphere to an oxidative one, due to the photolysis of water, hydrogen peroxide also appeared. In order to continue chemical evolution, it was necessary to develop a mechanism for the destruction of the large amounts of hydrogen peroxide. These mechanisms are described. I.v.L.

N64-29673 Notre Dame U., Ind.
CHRONIC EFFECTS OF IONIZING RADIATION ON THE HEMATOPOIETIC SYSTEM Final Technical Report
Charles E. Brambel 1 Jul. 1964 482 p refs
(Contract DA-49-007-MD-955)
(AD-602135)

Frequent quantitative measurements were made of the cellular composition of blood and blood-forming tissues and of the major protein components of serum. Massive recovery of splenic erythropoiesis under continuous radiation exposure, in the absence of marrow recovery, was noted. This pointed to a potential role of the spleen for survival under the experimental conditions used, and comparisons of splenectomized with nonsplenectomized animals were also performed. Author

N64-29699* Houston U., Texas
PREBIOLOGICAL SYNTHESIS OF COMPONENTS OF NUCLEIC ACIDS [DOBIOLOGICHESKIY SINTEZ KOMPONENTOV NUKLEINOVYKH KISLOT]
Juan Oro Repr. from Probl. Evolyutsionnoy i Tekhn. Biokhim., (Moscow), Izd. Nauka [1963] p 63–69 Transl. into RUSSIAN of an Article from Ann. N.Y. Acad. Sci., v. 108, 29 Jun. 1963 p 464–481 refs
(Grant NsG-257)

An investigation into the origin of living terrestrial organisms leads to the problems of the origin of albumen and nucleic acids, and of the prebiological organization of unicellular components of the biological macromolecules. The present article examines the nonenzymatic synthesis of the components of nucleic acids, and puts forth experimental evidence and theoretical considerations of the abiogenic organization of neurines, pyrimidines, and pentosribose and 2-deoxyribose. Trans. by M.B.S.

N64-29722* Mississippi State U., State College
EXTRACELLULAR POLYSACCHARIDES OF ALGAE: EFFECTS ON LIFE-SUPPORT SYSTEMS
B.G. Moore and R. G. Tischer Repr. from Sci., v. 145, no. 3632, 7 Aug. 1964 p 586–587
(Grant NsG-80)

The amount of extracellular polysaccharide produced by eight species of green and blue–green algae ranges from 173 mg/liter to 557 mg/liter. Most of the polymers are composed of four monosaccharides: a hexose, a pentose, a methyl pentose, and uronic acid. The production of excessive amounts of these photosynthetic end products will undoubtedly influence the effective recycling time of growth media in life-support systems. Author

N64-29725* California U., Berkeley Donner Lab.
CONDUCTION BLOCKAGE IN NERVE WITH HIGH ENERGY IRRADIATION
C. T. Gaffey Repr. from Radiation Res., v. 22, no. 1, May 1964 1 p
(NASA-Order R-104)

Experiments on conduction blockage, in the isolated sciatic nerve from *Rana pipiens*, with high-energy irradiation are reviewed. A massive dose (450,000 rad) of high-energy alpha particles and protons produced an immediate and irreversible blockage of conduction when the whole nerve was irradiated. Lower doses of these high-energy particles were effective in inhibiting neural conduction. In other experiments, irradiation with 50-Mev protons and 120-Mev alpha particles was restricted to small lengths of the nerve. It was found that millions of rads of high-energy irradiation failed to induce blockage in conduction. Experiments were performed in which the segment of the nerve exposed to high-energy irradiation was increased in 0.279-mm steps. When 1 mm or less of the nerve was irradiated with two or three million rads of high-energy alpha particles and protons, there was a failure to block transmission. If more than 1.4 mm of the nerve was irradiated, there was an immediate interruption of conduction. The relevance of this finding to brain surgery was investigated. I.v.L.

N64-29730* National Aeronautics and Space Administration, Washington, D.C.
CERTAIN PROBLEMS AND PRINCIPLES OF THE FORMATION OF A HABITABLE ENVIRONMENT BASED ON THE CIRCULATION OF SUBSTANCES [NEKOTORYYE PROBLEMY I PRINTSIPY FORMIROVANIYA OBITAYEMOY SREDY NA OSNOVE KRUGOVOROTA VESHCHESTV]
A. M. Genin and Ye. Ya. Shepelev Sep. 1964 10 p refs Transl. into ENGLISH of a Paper Presented at the 15th Intern. Astronautical Congr., Warsaw, 7–12 Sep. 1964
(NASA-TT-F-9131)

An examination is made of the organization of a closed ecological system as a new form of the unity of man and his environment under conditions of very limited space. In its basic layout, a system can be closed only in respect to one element, or parts thereof, and does remain open in respect to other substances being used from the supplies afforded. The possibility of chemical synthesis of certain nutritive substances is considered, and the conclusion is reached that some way must be found of transforming the indigestible part of the selected plants into digestible food containing animal proteins. A.W.

N64-29742 Joint Publications Research Service, Washington, D.C.
CONTROL SYSTEMS IN ORGANIC NATURE AND THE GENERAL UNDERSTANDING OF LIFE PROCESSES
A. A. Lyapunov *In its* Probl. of Cybernetics, No. 10, 1963 10 Sep. 1963 p 282–302 (See N64-29733 21-20) OTS: $7.40

This article contains three chapters as follows: (1) "The Cybernetic Approach to Theoretical Biology"; (2) "An Analysis of the Definition of Life"; and (3) "A Comparison of the Definition of Life with the Data of Biology." I.v.L.

N64-29759 Joint Publications Research Service, Washington, D.C.
STUDIES IN RADIATION SICKNESS TREATMENT
L. V. Orlova et al 24 Sep. 1964 16 p refs Transl. into ENGLISH LISH from Med. Radiol. (Moscow), v. IX, no. 6, Jun. 1964 p 19–21, 43–47
(JPRS-26542; TT-64-41800) OTS: $1.00

Adrenocorticotrophic hormone (ACTH) with prolonged action increased the survival of rats when administered for 6 days prior to irradiation, with daily doses of 0.25 to 1 unit. Preparation of lagochylus in treatment of acute radiation sickness induced by polonium should be used in combination with unithiol. In the conservative treatment of skin ulcers caused by radiation, cigerol is preferred to linol. A.W.

N64-29768 Flying Personnel Research Committee (Gt. Brit.)
DECOMPRESSION SICKNESS AT 18,500 FEET. A CASE HISTORY WITH COMMENT
D. I. Fryer (Inst. of Aviation Med., RAF) London, Min. of Aviation, Nov. 1963 8 p refs
(FPRC/Memo.199)

A pilot, aged 33 and considerably overweight, was exposed to an altitude of 18,500 ft in an unpressurized aircraft. After 2 hours he began to develop symptoms that progressed over 1 1/2 hours, by which time he had limb and joint pain, tightness of the chest, visual disturbance, headache, and general weakness. The symptoms improved on descent, but he collapsed shortly after landing at the completion of the 9 1/2-hour flight. He then developed a migraine-like syndrome. In addition he had skin mottling, irritability, symptoms in the central nervous system, hemo concentration, and a raised CSF protein. His condition slowly returned to normal over the following 3 to 4 days. Author

N64-29846 Federal Aviation Agency, Oklahoma City, Okla. Civil Aeromedical Research Inst.
A METHOD FOR THE MEASUREMENT OF PHYSIOLOGIC EVAPORATIVE WATER LOSS
Thomas Adams, Gordon E. Funkhouser, and Warren W. Kendall (Okla. U.) Oct. 1963 18 p refs
(CARI-63-25; AD-603418)

This report describes a technique for measuring local sweat responses, which is relatively inexpensive, highly stable, and accurate. Basically, the system uses a thermal conductivity cell for the detection of water vapor in an air stream passing over the skin. A method for calibration of the unit and examples of its application in physiological and psychological testing are described. Author

N64-29857 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
CONTEMPORARY MEANS FOR EMERGENCY ABANDONMENT OF AIRCRAFT (SELECTED CHAPTERS)
S. M. Alekseyev, Ya. V. Balkind et al 2 Jun. 1964 202 p refs Transl. into ENGLISH from the book "Sovremennyye Sredstva Avariynogo Pokidaniya Samoleta" Moscow, Gosudarstvennoye Nauchno-Tekhn. Izd., Oborongiz, 1961
(FTD-TT-63-420/1+2; AD-602689)

Selected chapters from the book, "Contemporary Means for Emergency Abandonment of Aircraft," are presented. Chapters are: (1) "General Data on Contemporary Facilities for the Rescue of an Aircraft Crew under Emergency Conditions"; (2) "High-Altitude and Protective Equipment"; and (3) "Testing of Survival and Rescue Equipment." I.v.L.

N64-29872 Chicago U., Ill. USAF Radiation Lab.
[CERTAIN BIOLOGICAL AND MEDICAL ASPECTS OF RADIATION] Quarterly Progress Report
Kenneth P. Du Bois 15 Jul. 1964 207 p refs
(Contract AF 41(609)-1693)
(QPR-52; AD-603561)

The three sections of this report, and papers presented under each section, are as follows: (1) The Effect of Ionizing Radiations on the Biochemistry of Mammalian Tissues—"The Influence of X-radiation and Various Chemical Agents on the Development of a Thiophosphate-Oxidizing Enzyme System in the Livers of Male Rats," "The Influence of X-irradiation on Steroid-Induced Increases in the Activity of a Detoxification Enzyme in Liver," and "Studies on the Toxicity and Mechanism of Action of 2-Mercaptoethylamine"; (2) Pharmacological and Toxicological Compounds as Protective or Therapeutic Agents against Radiation Injury in Experimental Animals—"The Influence of Various Chemical Compounds on Radiation Lethality in Mice," "Studies on Tissue Oxygen Levels and Radioprotection with Anoxia and Serotonin in Mice," and "Studies on the Toxic and Radioprotective Effects of Cyclobutane Derivatives"; and (3) The Influence of Exposure to Low Levels of Gamma and Fast Neutron Irradiation on the Life Span of Animals—"Histopathologic Findings in the Tissues of Mice Given Daily X-ray Exposures with or without Liver Shielding, and Hematological and Histopathological Findings in the Tissues of Mice Fed Diets Containing Para-aminopropiophenone and the Effect of Daily X-ray Exposure on these Findings." I.v.L.

N64-29885 Portugal Nuclear Energy Commission, Sacavem De Fisica e Engenharia Nucleares
THE AUTORADIOGRAPHIC STUDY OF INCORPORATION OF TRITATED THYMIDINE INTO HUMAN CHROMOSOMES. PART I: PRELIMINARY STUDIES [ESTUDO AUTORADIOGRAFICO DA INCORPORACAO DA TIMIDINA TRITIADA EM CROMOSOMAS HUMANOS. I: PRIMEIROS ENSAIOS]
A. A. Teixeira Pinto 1964 25 p refs In PORTUGUESE; ENGLISH summary Work done in conjunction with Lisbon U.
(LFEN-NI.11 (α))

The incorporation of tritiated thymidine into the DNA molecule associated with the autoradiographic method is a well-established aid in the study of DNA synthesis. Some advantages and disadvantages in using tritiated thymidine in living cells are pointed out, and the tissue culture technique, as well as the autoradiographic method, are reported. Author

N64-29906 California U., Berkeley Sanitary Engineering Research Lab.
A STUDY OF FUNDAMENTAL FACTORS PERTINENT TO MICROBIOLOGICAL WASTE CONVERSION IN CONTROL OF ISOLATED ENVIRONMENTS First Technical Report
C. G. Golueke, W. J. Oswald, and H. K. Gee 31 Mar. 1964 73 p refs
(Contract AF 19(628)-2462)
(SERL-64-5; AFCRL-64-341; AD-604882)

This report describes studies concerned with the determination of an optimum light arrangement for promoting algae growth, the design and construction of a unit incorporating

these findings, the design and operation of specialized units to obtain effective waste treatment, and the development of an advanced model of the microterella. Author

N64-29938 Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio Biomedical Lab.

PATHOLOGY AND TOXICOLOGY OF REPEATED DOSES OF HYDRAZINE AND 1,1-DIMETHYLHYDRAZINE IN MONKEYS AND RATS Technical Documentary Report, Mar. 1962–Dec. 1963

Roman L. Patrick and Kenneth C. Back Jun. 1964 18 p refs
(AMRL-TDR-64-48; AD-604525) OTS: $0.50

In the hydrazine-treated group of monkeys, serum glutamic oxaloacetic transaminase and bilirubin rose with doses of 20 mg/kg, with more than a twentyfold increase of SGOT in two animals. Most of those receiving 20 mg/kg exhibited loss of appetite, vomiting, lethargy, and severe weakness. Microscopic examination revealed lipid accumulation in the liver, myocardium, kidney, and skeletal muscle. Massive liver necrosis was observed in one animal. In those monkeys receiving UDMH, blood glucose rose significantly toward the end of the experiment. Some lipid was deposited in the heart, liver, and kidney, but to a much lesser degree than was observed with hydrazine, and it could only be demonstrated with special fat stain. Rats given from 3 to 23 doses of 10 or 20 mg/kg/day hydrazine did not show marked fatty changes as observed in the monkeys. Author

N64-29939 Army Natick Labs., Mass.

DEVELOPMENT OF FOOD ITEMS TO MEET AIR FORCE REQUIREMENTS FOR SPACE TRAVEL

Herbert A. Hollender Wright-Patterson AFB, Ohio, Biomed. Lab., Jun. 1964 63 p
(Contract AF 33(616)-6118)
(AMRL-TDR-64-38; AD-604737) OTS: $1.75

Prototype foods to meet the requirements of space travelers have been investigated. These foods were required to be lightweight, easy to prepare, highly nutritious, neither thirst provoking nor gas forming, and low in crude fiber. The food should not exceed a cube size of 1/4 to 3/8 inch and should, after storage up to 6 months at 40°, 70°, and 100° F, closely resemble the color, flavor, and texture of fresh food. Freeze-dehydrated foods were investigated. Certain tubed foods were studied to determine whether they were acceptable after storage up to 15 months at 40°, 70°, and 100° F. Many tubes showed internal swelling. Peaches, apricots, beef and vegetables, and beef and gravy in tubes with Sunex 11-S lining were found to be acceptable in both texture and taste. Studies of Chlorella 71105 were made to modify the flavor, taste, and color and to enhance the nutritive values. Author

N64-29941 Cincinnati U., Ohio Coll. of Medicine

METABOLIC CHANGES IN HUMANS FOLLOWING TOTAL BODY IRRADIATION, 1 NOVEMBER 1961–30 APRIL 1963

Eugene L. Saenger [1963] 57 p refs
(Contract DA-49-146-XZ-029)
(DASA-1422; AD-604478)

This report summarizes the work carried out on 10 additional patients given acute, whole-body irradiation. The radiation doses administered to these patients ranged from 155 to 336 midline air dose (100 to 200 rad midline tissue dose). Results and conclusions from this research include the following: (1) A new technique has been developed for identification of deoxycytidine, presumably a breakdown product of DNA. Deoxycytidine has been identified in urine following whole-body irradiation. (2) Xanthurenic acid, an end product of tryptophane metabolism, has been found in the urine of some of the patients after whole-body irradiation. (3) Chromosomal abnormalities have been identified in white cells immediately after irradiation. (4) Human beings can tolerate doses of 200 rad (300 r) relatively well as far as combat effectiveness is concerned, but it is probable that a second dose of the order of 200 rad, even after apparent complete recovery, will result in a significant number of individuals becoming combat ineffective immediately. Author

N64-29974 Farr Cytochemical Labs., Camden, Me.

RESEARCH ON THE CYTOCHEMISTRY OF CELL WALLS OF MICROORGANISMS

Wanda K. Farr Wright-Patterson AFB, Ohio, AMRL, Jun. 1964 94 p refs
(Contract AF 33(657)-10166)
(AMRL-TDR-64-52; AD-605213) OTS: $2.25

As a part of the research program designed to solve the nutritional problems of astronauts during extended explorations of space, cell wall substances of four fungi, *Heterocephalum aurantiacum, Spicaria sp., Cladosporium sp.* and *Linderina pennispora* have been identified and localized by standard cytochemical methods. Chitin is the resistant cell wall material in the component cells of all of these fungi, and results of efforts to identify cellulose in the same cell walls have been negative. Excretions that accumulate on the surfaces of the aerial corticating hyphae of *H. aurantiacum* are composed primarily of calcium salts and an unidentified colloidal material, yellow–orange in color and having many characteristics in common with the so-called "fungal gamboge." Reactions of the previously untreated chitinous cell walls to the enzyme, chitinase, are positive. Enzymatic hydrolysis represents the most suitable method now available for the conversion of chitin to N-acetylglucosamine with the accompanying breakdown of the cell wall and concurrent release of nutritive substances in the protoplast. Author

N64-29988 Florida U., Gainesville Coll. of Medicine

MEASUREMENT OF AIRWAY RESISTANCE WITH A VOLUME DISPLACEMENT BODY PLETHYSMOGRAPH

M. J. Jaeger and A. B. Otis Brooks AFB, Tex., SAM, Jun. 1964 17 p refs
(Contracts AF 41(657)-102; AF 41(609)-1553)
(SAM-TDR-64-17; AD-604464)

Airway resistance was measured with a volume displacement body plethysmograph in 40 normal subjects breathing at their spontaneous breathing rate. The measurements are based on a method designed by DuBois et al., which was modified in order to extend its applicability. The subjects were rebreathing from a bag containing gas at approximately BTPS conditions. Possible errors in conditioning the gas in the bag were corrected mathematically. The values of airway resistance obtained (1.26 ±0.39 cm. H_2O per liter per second) agree with those published by DuBois et al. and by other authors using the same technique. The measurements were found to correlate with results obtained on the same subjects with related techniques. The paper also includes measurements of lung-tissue viscous resistance and inertance of the gas in the airways. Author

N64-29989 Ohio State U. Research Foundation, Columbus
CATHETER-TIP FLOWMETER FOR THE MEASUREMENT OF CORONARY ARTERIAL BLOOD FLOW IN INTACT ANESTHETIZED DOGS
Heinz P. Pieper Brooks AFB, Tex., Sam, Jun. 1964 12 p refs
(Contract AF 41(609)-1454)
(SAM-TDR-64-33; AD-604465)

A catheter-tip flowmeter has been designed for the measurement of coronary arterial blood flow in closed-chest dogs. The miniaturized flowmeter is attached to the tip of a rigid catheter, which is inserted through the right carotid artery. The flowmeter is placed in the ascending aorta where it measures the inflow into the left coronary artery. Performance tests show the reliability of the instrument for the measurement of pulsatile flow. The flowmeter has been applied to determine the pressure-flow relationship of the coronary system of closed-chest anesthetized dogs. This pressure-flow relationship is obtained over the pressure range of greatest physiologic importance and describes the system for a constant set of cardiovascular conditions. Author

N64-29995 Naval School of Aviation Medicine, Pensacola, Fla.
INTERDEPENDENCE AMONG SOME FACTORS ASSOCIATED WITH CORONARY HEART DISEASE
Albert Oberman, Richard E. Doll, and Ashton Graybiel 5 Mar. 1964 21 p refs
(Rept.-9; AD-601992)

Interrelations among certain factors predisposing to coronary heart disease were evaluated in a prospective study of healthy young men followed for an 18-year period. Analyses of these noncontinuous data by means of chi squares and contingency coefficients reveal significant associations. Pertinent findings are discussed in relation to present knowledge of the epidemiology of coronary heart disease. Author

N64-30036 Argentina Comision Nacional de Energia Atomica, Buenos Aires
THE SILVER HALIDES AS SEPARATION AGENTS OF THE RADIOIODIDE ION [LOS HALUROS DE PLATA COMO AGENTES SECUESTRANTES DEL ION RADIOIODURO]
Leopoldo J. Anghileri 1964 10 p refs In SPANISH *Its* Informe No. 116

Silver iodide and silver chloride have been used successfully as sequestering agents for the radioactive iodine ion. The amount of radioactive ion separated by the salt was measured by precipitating the reaction product on a gelatin substrate. The effects of ion concentration, substrate concentration, temperature, pH, and silver concentration were measured. Silver chloride was found to be about 10% more effective than silver iodide at all concentrations. D.E.R.

N64-30156 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
INTERACTION OF SIMULTANEOUS REACTION CONDITIONS OF HUMANS [VZAIMODEYSTVIYE ODNOVREMENNYKH USPOVNYKH REAKTSIY U CHELOVEKA]
N. Yu. Alekseyenko 5 Aug. 1964 41 p Transl. into ENGLISH from Izd. Akad. Nauk SSSR (Moscow), 1963 p 1–41
(FTD-TT-64-282/1+2; AD-605243)

Relationships between the movments of both hands during hemiparesis were investigated. It was found that, under conditions approaching simultaneity, the conditioned reflexes of animals (as well as of human beings) interfere with and retard each other. However, after a period of training, a pair of reactions appear to lose their mutually hindering properties. Several experimental programs on these subjects are reviewed. Experiments were carried out on human beings to determine the relationships of conditioned reflexes in response to acoustic, electric, and tactile stimulation. D.E.W.

N64-30169 Naval Air Development Center, Johnsville, Pa. Aviation Medical Acceleration Lab.
A DISCUSSION OF MEDICAL MONITORING IN RELATION TO SAFETY IN CENTRIFUGE OPERATIONS Report No. 10
Stuart Ragland, Jr. 17 Jun. 1964 12 p refs
(NADC-ML-6410; AD-602779)

The importance of a continuous voice communication loop between the subject and monitor is stressed so that the monitor can make continuing judgments regarding the subject's condition based on the appropriateness of answers, occurrence of coughing, etc. Great emphasis is placed on the importance of closed circuit television as an aid in monitoring, since the appearance of the subject's face, especially his eyes, can be checked for changes during the runs. The role of the electrocardiogram in monitoring is discussed, as are some of the problems developed during acceleration runs. Some of the factors involved in proper selection of subjects for centrifuge experimentation also are presented. Author

N64-30195 Miami U., Coral Gables, Fla. Marine Lab.
A SUMMARY OF EXISTING INFORMATION ON THE FRESH-WATER BRACKISH-WATER AND MARINE ECOLOGY OF THE FLORIDA EVERGLADES REGION IN RELATION TO FRESH WATER NEEDS OF EVERGLADES NATIONAL PARK
Durbin C. Tabb Dec. 1963 156 p refs
(ML-63609)

Existing information on the fresh-water, brackish-water, and marine ecology of the Florida Everglades region is summarized in relation to fresh-water needs of the Everglades National Park. There have been pronounced changes in the water level, water supply, and water dispersal in the area in and around the Park, and these changes are still going on. The major changes in the watershed, exclusive of the completion of Conservation Area 3, took place prior to the final establishment of the Park boundaries in 1947; the Park biota had probably adjusted to these major changes by that time. If it is desirable to restore the park water budget to the predrainage conditions, thorough studies of the ecological requirements of the flora and fauna will first be required, as well as research on the conditions of runoff that are required to maintain these elements in the virgin state. As long as the region is a national park, the Park Service Administration should resist any manmade water control structures within the Park boundaries. I.v.L.

17 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and materials fabrication, handling and inspection. *For related information see* 08 Auxiliary Systems.

N64-29216* Florida U., Gainesville Engineering and Industrial Experiment Station
STUDY OF AGE DETERIORATION OF GASKET MATERIALS INSTALLED IN SIMULATED LAUNCH VEHICLE HARDWARE Semiannual Technical Report
J. A. Samuel [1964] 4 p
(Contract NAS8-1523)
(NASA-CR-58713) OTS: $1.10 ph

Results of leakage tests are summarized as follows: (1) There were no significant variations in the results from those obtained during previous tests in November, 1963. In no case did the leakage rate exceed the allowable rate. However, the following results should be pointed out: (1) Fixture 6–17, valve assembly MV-76, did not show any leakage in this test, whereas in the previous test there was a leak of 20 cc/min at the stem. (2) Fixture 8-1A, a thrust chamber seal, leaked at 113 cc/min as compared with 36 cc/min in November, 1963, and 80 cc/min in April, 1963. (3) Fixture 9-2A, a thrust chamber seal, showed a leak rate of 30 cc/min as compared with no leak in November, 1963. (4) Fixture 10-2A, a thrust chamber seal, showed a leak rate of 320 cc/min as compared with an allowable rate of 409 cc/min. This unit has leaked at approximately the same rate at each test since April, 1960. (5) Fixture 16-12, a bolted O-ring, showed a small leak at the juncture of the inlet flare fitting and the body of the flange. This leak does not in any way affect the performance of the installed O-ring. I.v.L.

N64-29223* Ion Physics Corp., Burlington, Mass.
CATHODE LIFETIME STUDIES Final Summary Report
William Sirois 31 Aug. 1964 70 p refs
(Contract NAS3-3563)
(NASA-CR-54109) OTS: $6.60 ph

Experimental and analytical studies designed to determine the performance and reliability indirectly heated nickel-matrix cathodes as electron sources in ion engines are described. Cathode performance has been evaluated in vacuum diodes and in simulated ion engines operating on mercury. The results of both the temperature cycling (simulated pulsed operation) and mercury lifetime (d.c. engine operation) tests are presented. This program has shown the present heater geometry to be unsatisfactory for the engine application. The problem of emission degradation of this type of cathode, observed at other facilities, is discussed. Author

N64-29225* Ryan Aeronautical Co., San Diego, Calif.
NASA S-1C 2219-T37 GORE SECTION EXPLOSIVE FORMING DEVELOPMENT PROGRAM. SUMMARY OF PHASE II: SUB-SCALE EXPLOSIVE FORMING
H. F. Wallen 5 Jun. 1964 33 p
(Contract NAS8-5129)
(NASA-CR-58719; Rept.-64B079A) OTS: $3.60 ph

Objective of this program was to further prove the gripping ability of the two clamps recommended previously. Four-in. wide clamps were used to run tests in the 2 X 4ft subscale explosive form die. The self-energizing clamp was eliminated because the adjustment of the gripping angle was too critical to be practical under production conditions. Then, four stretch-press type clamps 13-in. long were made and evaluated, and proved to have adequate gripping power to elongate the 0.800-in. 2219-T37 aluminum 2 1/2% to 3%. The gripping of all clamps was uniform enough under explosive conditions to prevent failure due to local overloading. Full-scale tests, using lead shims that were added to the edges of the base gore die, proved the validity of balancing the elongation so that the edge material drew into the die more uniformly. Preliminary information was gained by mounting the four clamps from the subscale die at center points on each side of the base die. From this data, it was decided to add five stretch press type clamps to the apex die, and nine to the base die. Author

N64-29226* Ryan Aeronautical Co., San Diego, Calif.
NASA S-1C 2219-T37 GORE SECTION EXPLOSIVE FORMING DEVELOPMENT PROGRAM. SUMMARY OF PHASE III: FULL SCALE EXPLOSIVE FORMING OF APEX AND BASE GORE SEGMENTS
H. F. Wallen 5 Jun. 1964 65 p
(Contract NAS8-5129)
(NASA-CR-58718; Rept.-64B080A) OTS: $6.60 ph

The objective of this research was to determine whether it is practical or even possible to restrain 2219–T37 aluminum by mechanical means so that a nonsymmetrical part can be formed with a minimum of distortion due to springback. This program was specifically aimed at forming apex and base gores to be welded into bulkhead domes for the Saturn V tanks. It was found that 2219–T37 aluminum can be held with sufficient force to elongate material 0.800-in. thick, 2% to 3%. Balancing the elongation so that it is reasonably the same along each grid line aids forming. These concepts were applied to the forming of gores. Although parts formed were not close to print requirements at the time of the contract termination, sufficient progress had been made to prove that the draw at the edges of the blank can be controlled to where a part can be made to print requirement, assuming that some over-form was built into the die. Author

N64-29230 Naval Air Engineering Center, Philadelphia, Pa.
INFORMATION ON ORGANIC COATING MATERIALS FOR SERVICE EVALUATION
[1964] 16 p
(NAEC-AML-1965; AD-442082)

Eleven materials are evaluated as to their performance and use as aircraft coatings. Information is given on properties, quantities, and application of diester oil-resistant fluorescent coating, polyurethane insignia colors, gloss white polyurethane, aircraft gray silicone alkyd-epoxy heat-resisting enamel, light gull gray polyurethane, light gull gray acrylic lacquer, polyurethane elastomeric coating, and gloss white acrylic lacquer, among others. A.W.

N64-29244 Rock Island Arsenal Lab., Ill.
EVALUATION OF PHOSPHATE FINISHES ON STEEL AS UNDERCOATS FOR ARMY PAINT SYSTEMS
J. Knanishu 26 Nov. 1963 43 p refs
(Rept.-63-3893; AD-602716) OTS: $1.25

Fifty different sets of prepared specimens were used in this study. Forty-one commercial phosphating products, 3 commercial wash primers, and 4 phosphating process solutions. Also included was a diluted commercial phosphoric acid rust remover and metal conditioner and one control set comprised only of cleaned steel. All phosphated panels were processed in accordance with directions supplied by the manufacturer. Six panels from each of the 50 sets of panels prepared were coated with 1 of the 9 different systems of organic coatings. The prepared panels were scored and mounted on outdoor exposure racks. This report covers the results of 8 years of South exposure (at 45°). Author

N64-29298 Aeroprojects, Inc., West Chester, Pa.
DEVELOPMENT OF ULTRASONIC WELDING EQUIPMENT FOR REFRACTORY METALS Interim Technical Progress Report, Apr.–Jun. 1964
Nicholas Maropis Wright-Patterson AFB, Ohio, ASD, Jul. 1964 13 p refs
(Contract AF 33(600)-43026)
(RR-64-53; ASD-TR-7-888(IX); ASD-IR-7-888(IX); AD-444988)

The 15-kc, 4.2-kw ceramic transducer assembly incorporating the improvements shown to be necessary during this development effort was evaluated. Its performance was determined by means of an acoustical calorimeter and exceeded the requirements initially established as necessary for joining the several refractory metals and superalloys in thicknesses up to 0.10 inch with the projected 25-kw ultrasonic welding machine. Author

N64-29305 Picatinny Arsenal, Dover, N.J. Feltman Research Labs.
A GLASS-FILIMENT-WOUND GROMMET FOR THE 155 MM T387E2 (M470) PROJECTILE
Merrill Eig and Harvey Peritt Oct. 1963 32 p
(TM-1155; AD-424608)

A filament-wound polyester grommet to protect the rotating band of the 155-mm T38E2 (M470) projectile has been designed, and a process for its fabrication has been established. The grommets were satisfactorily field tested under ambient conditions. They were drop tested at −40° and 160° F. Author

N64-29317 Explosiform, Inc., Park Forest, Ill.
DIRECT CONTACT EXPLOSIVES METALFORMING Interim Engineering Progress Report, 1 Jun.–31 Aug. 1964
Jacob Savitt Wright-Patterson AFB, Ohio, AF Mater. Lab., Sep. 1964 15 p refs
(Contract AF 33(615)-1722)
(IR-8-238(I); AD-446367)

Initial effort and progress on a research and development program directed toward the development of an effective, economical, and substantially improved explosives metalforming system, which does not require conventional pressure transmitting media, are described. A review of the principles on which this forming system is based is presented, and some of its inherent advantages and disadvantages are discussed. Dies, workpieces, and explosives charges for preliminary forming tests are described, and the results of the first successful test fabrications of hemispheres are presented. Author

N64-29345 Sprague Electric Co., North Adams, Mass.
PRODUCTION ENGINEERING MEASURE FOR IMPROVED RELIABILITY OF SOLID ELECTROLYTE TANTALUM CAPACITORS Quarterly Report, Sep. 29–29 Dec. 1963
J. M. Eckfeldt and J. H. D. Folster [1963] 19 p
(Contract DA-36-039-AMC-03621(E))
(QR-2; AD-601826)

The processing of experimental lots through the production line continued. A total of 24 lots have now been processed since the beginning of the contract. This report contains the description of the various experimental processing techniques incorporated in the latest 14 lots. Also provided are preliminary data on the first 14 lots to complete manufacture and 1,000-hr life test data on six of these. The work on the mechanization of the assembly operation has continued. Three of the seven equipments being built have been completed, and another is partially completed. The design of the other three is continuing. Author

N64-29349 Mechanical Technology, Inc., Latham, N.Y.
EXPERIMENTAL STUDY OF ELASTOHYDRODYNAMIC LUBRICATION
F. K. Orcutt 8 Jul. 1964 44 p refs
(Contract Nonr-3729(00)(FBM))
(MTI-64-TR37; AD-602792) OTS: $3.00

This report describes direct experimental measurements of pressure distribution, surface temperature, and film shape or deformation profile that have been obtained during an investigation of elastohydrodynamic lubrication. These measurements illustrate effects of loads, rolling speed, lubricant properties, and sliding speed. Their purpose is to provide guidance and verification for the development of an elastohydrodynamic theory, which can then be generally applied to practical problems in the manner that has been described. The results agree with the thermal-elastohydrodynamic theory of Cheng in many respects, but there are also differences indicating that certain modifications in the formulation of the theory should be made. Author

N64-29399 Frankford Arsenal, Philadelphia, Pa.
DEVELOPMENT OF PRESSURE WELD PAD CARTRIDGE SEAL
J. B. Mc Cormick Feb. 1963 38 p refs
(R-1666; AD-299586)

This report presents major aspects involved in obtaining a satisfactory seal by the application of pressure-weld process to Propellant Actuated Devices (PAD) for advanced flight vehicles. The objective is to determine the feasibility of this process for replacement of O-ring sealing in those environments where it is inadequate. Two different cartridge designs were developed as an approach to the solution of the problem. Leak-detection tests and limited ballistic testing were performed under conditions similar to those used for the standard M91 cartridges. Results of these tests were evaluated and compared to standard cartridge performance characteristics. These investigations determined that this pressure-welding process is feasible and adaptable to both present and future PAD devices. Author

N64-29412 Cook Electric Co., Dayton, Ohio Inland Testing Labs. Div.
QUARTZ CRYSTAL RELIABILITY STUDIES Final Report, 5 Apr. 1962–30 May 1964
Carleton E. Jones [1964] 73 p
(Contract DA-36-039-SC-89199)
(Rept.-4; AD-602275) OTS: $2.25

A total of 600 military-type quartz-crystal units were subjected to testing under closely controlled conditions. Of these crystal units, 26 were rejected during the preproduction tests. One-half of these rejections were due to leakage of the crystal holders. The other failures were distributed among broken support wires, fractured quartz plates, broken connections between the support wires and the quartz plates, and broken or cracked glass holders. During the 5,000-hour Phase II tests, 60 additional crystal units were classified as failures because of excessive frequency shifts or of failure to oscillate. The failure rates are shown by crystal type and test condition, and reasons for failure are noted. The Phase III tests (a redetermination of the frequency–temperature characteristics) of the crystal units were completed without any failures. Four crystal units failed during the performance of the Phase IV shock and vibration tests. All four were of the same type of crystal and failed during vibration testing. The distribution of causes of failure for the 600 crystals studied is presented graphically. It is concluded that failures attributed to causes other than leakage can be considered random or chance failures. D.E.W.

N64-29508* Marlin-Rockwell Corp., Jamestown, N.Y. Research and Development Labs.

SURVEY OF FRICTIONAL PROBLEMS IN SPACECRAFT Final Report

John H. Johnson and Arthur S. Irwin 16 Feb. 1964 160 p refs

(Contract JPL-N2-150168)

(NASA-CR-58704) OTS: $11.50 ph

A survey of frictional problems in spacecraft mechanisms, conducted to determine the degree of research and development effort that is required to solve the problems introduced by the space environment, is discussed. The survey covered bearings, gears, and seals. It is concluded that research should concentrate on implementing design decisions, developing new mechanical design concepts, and basic investigations to develop materials and lubricants for the future. It is also concluded that more emphasis on lubrication is warranted. P.V.E.

N64-29520* Republic Aviation Corp., Farmingdale, N.Y. Manufacturing Research Dept.

DEVELOPMENT OF TECHNIQUES AND TOOLING FOR SPIN DRAWING OF PORT CONFIGURATIONS Final Report, Jun. 4, 1962–Sep. 18, 1963

J. Mainhardt and W. Matlach Sep. 1963 138 p refs

(Contract NAS8-2698)

(NASA-CR-58362; RAC-1734) OTS: $10.50 ph

Flanged nozzle ports suitable for attachment of conduits were formed from 2219 aluminum alloy in a number of configurations ranging up to 26 in. in diameter. With the forming technique used, average elongations up to 35% were achieved in 2219-T37 material while maintaining material property requirements. A.W.

N64-29555 Owens-Corning Fiberglas Corp., Toledo, Ohio

GLASS REINFORCEMENTS FOR FILAMENT WOUND COMPOSITES Final Technical Engineering Report, Aug. 1962–Dec. 1963

Edwin M. Lindsay and James C. Hood Wright-Patterson AFB, Ohio, Mfg. Technol. Div., Dec. 1963 161 p refs

(Contract AF 33(657)-9623)

(TR-64-8-104; AD-602503)

An investigation of the process for manufacturing glass-fiber reinforcements for filament winding plastic composite structures was completed. The data indicate that the difference between average virgin fiber strength and roving strength is 20%. Experiments were run on every step in the process from the bushing through roving, and material was tested at intermediate points. The results show that the difference between average virgin fiber strength and roving strength in a composite cannot be attributed to any specific process operation. If there is actually a loss in fiber strength from virgin fiber to roving, presently available test methods are unable to measure it. Author

N64-29564* Lockheed Missiles and Space Co., Sunnyvale, Calif. Nuclear Space Programs

EXPERIMENTAL TOOL PROGRAM

21 May 1963 21 p NSP Presentation to RIFT Mfg. Eng. Working Group Meeting

(Contract NAS8-5600)

(NASA-CR-56508; NSP-63-64)

The RIFT Experimental Tool Program was initiated so that manufacturing problems can be resolved prior to actual hardware manufacture. Realizing the importance of the welding-process development, an experimental weld fixture has been programed that duplicates the more critical bulkhead-barrel and horizontal-girth weld areas. Sketches and descriptions of the following are presented: (1) a side beam with a "weld traveler" mounted in flat, horizontal, vertical, and 45° position in order to support preliminary weld development; (2) a girth weld-quarter bulkhead for external welds; (3) an abbreviated gore panel-fitting-installation weld fixture; (4) an abbreviated bulkhead-closure ring weld fixture; and (5) and a gore panel (quarter bulkhead), for internal welds. I.v.L.

N64-29565* General Electric Co., Schenectady, N.Y. Advanced Technology Labs.

DEVELOPMENT OF LOW TEMPERATURE DIELECTRIC COATINGS FOR ELECTRICAL CONDUCTORS Quarterly Report No. 11

K. N. Mathes 15 Apr. 1964 75 p

(Contract NAS8-2442)

(NASA-CR-58573) OTS: $7.60 ph

This report adds to and completes the physical and electrical measurements on round-wire and ribbon cables. These measurements include voltage breakdown tests made in air and liquid helium, with some additional tests in liquid nitrogen and at room temperature after exposure at high humidities. Flexibility measurements after aging 64 days at 120° C are reported for some samples at 23° C and in liquid helium. Results of these measurements have provided the basis for the selection of a round-wire cable design, and the basis for the selection of an unshielded ribbon cable design I.v.L.

N64-29566* Battelle Memorial Inst., Columbus, Ohio

STUDIES OF HIGH-FREQUENCY WELDING PROCESS Final Summary Report

W. K. Byrne, J. J. Vagi, and D. C. Martin 11 Jun. 1963 97 p

(Contract NAS8-2669)

(NASA-CR-58562) OTS: $8.60 ph

To obtain the needed information on the high-frequency welding process, the research was divided into three phases: (1) to study and develop the degree of applicability of the high-frequency welding process to space-launch-vehicle materials; (2) to study and develop the adaptability of the process, including necessary power frequencies and travel speeds, to the material thicknesses and configurations required for launch vehicles; and (3) to design tooling configurations as required for the establishment of final tooling parameters for a production system. Each of these program phases is discussed as follows; (1) process characteristics; (2) equipment; (3) materials; and (4) experimental procedures. Author

N64-29567* North American Aviation, Inc., Los Angeles, Calif.

HIGH VOLTAGE ELECTRON BEAM WELDING OF ALUMINUM ALLOYS Final Report

N. Klimmek 14 May 1964 98 p refs

(Contract NAS8-11085)

(NASA-CR-58563; NA-64-469) OTS: $8.60 ph

A research and development program conducted to determine the capability and limitations of high-voltage electron-beam welding equipment for joining high-strength aluminum alloys is described. Included are the results of studies pertaining to the following areas: the effects of high-strength aluminum alloys on a high-voltage electron-beam welding system; thickness limitations for high-voltage electron-beam welding of aluminum alloys; the effect of variations in lens current, travel speed, and cleaning procedure on weld depth-to-width ratio; the welded-aluminum joints; and electron-beam weld metal chemistry. Author

N64-29576 North American Aviation, Inc., Columbus, Ohio Engineering Dept.
IMPROVEMENT OF WIRE TEST METHODS Final Report
Jack L. Conrad 10 Mar. 1964 39 p
(Contract NOw-61-0238-D)
(NA63H-1108; AD-602122)

An engineering investigation, a survey, and a test program were conducted of aircraft interconnecting wire to determine realistic and definitive quality-control procedures. Specifically, the following acceptance tests were investigated: abrasion, flammability, tank dielectric, high-temperature endurance, wicking, and bondability and sealing. Each of these tests was reviewed with the goal of developing an optimum test procedure. Such a procedure was defined as one that would meet the following requirements: (1) simulate service conditions; (2) give consistent results; (3) be consistently interpreted; (4) be accomplished in a short time; and (5) be suitable for acceptance inspection. The standard military wire specifications, as used by the Navy, that were taken under consideration were MIL-W-5086, -7072, -7139, -8777, -25038, and -16878. I.v.L.

N64-29686 Westinghouse Electric Corp., Newbury Park, Calif. Astroelectronics Lab.
ADVANCED PROCESSING TECHNIQUES FOR CAMERA TUBES Interim Report, Feb.–May 1964
M. K. Kilcoyne and R. Florek [1964] 26 p ref
(Contract AF 33(615)-1238)
(IR-1; AD-602092) OTS: $0.75

The current program status is reviewed. All process-station modifications have been completed. Photodiode processing with S-20 and S-21 photosurfaces is currently underway. Diode evaluations have been initiated; however, insufficient data have been accumulated, up to the present time, to establish any reliable conclusions. Erratic readings on photocathodes have been caused by malfunctioning equipment. At the present time, all current monitoring meters have been repaired and calibrated. Faulty connections on the light source, which were a source of nonuniform levels of illumination, have also been repaired. I.v.L.

N64-29693* IIT Research Inst., Chicago, Ill. Technology Center
INVESTIGATION OF SLIP-RING ASSEMBLIES Final Report, 5 Mar. 1963–5 Mar. 1964
J. C. Horton [1964] 86 p
(Contract NAS8-5251; IITRI Proj. E6000)
(NASA-CR-58666) OTS: $8.10 ph

A laboratory investigation of miniature slip-ring assemblies was conducted to determine the influence of ring, brush, and insulator materials on electrical noise and mechanical wear characteristics. Electroplated rings of soft gold and two hard gold alloys coupled with brushes of Neyoro 28A, a precious metal alloy, exhibited extremely low noise levels, particularly when tested in a drive apparatus that introduced a minimum of mechanical disturbance. Pyrolysis studies of epoxy resins indicated that the major gases given off at low temperatues were low molecular weight gases such as hydrogen, carbon monoxide,and methane. No evidence of creepage or exudation of material from epoxy resins to adjoining metalic surfaces was obtained. Sublimation experiments indicated that condensible products were formed when epoxy resins were exposed to temperature gradients. Author

N64-29714 ARDE-Portland Inc., Paramus, N.J.
CRYOGENIC STRETCH-FORMING OF SOLID PROPELLANT Quarterly Report, Mar. 1, 1963–May 31, 1964
R. H. Alper [1964] 21 p
(Contract DA-30-069-ORD-3501)
(QR-8; AD-602774)

The effect of closer die tolerances and additional overpressure on the out-of-roundness of the Pershing subscale cases was examined and determined to significantly reduce the tolerances on the vessel. The effect of the addition of skirts and end rings to stretched Pershing subscale vessels on the room-temperature strength level was determined. No significant decrease in yield strength of the vessel was noted. The fabrication of the full-scale cases proceeded. Some problems in the spinning of the components for the full-scale preform were encountered and overcome. Design analysis of the stresses encountered during the stretching of both the subscale and projected full-scale cases indicated marginal stresses in the vicinity of the juncture of the aft cone and the aft cylinder of the preform. Author

N64-29778 Toegepast Natuurwetenschappelijk Onderzoek, Delft (Netherlands)
SAP WELDING AND FORMING BY MEANS OF EXPLOSIVES [SALDATURA E FORMATURA DEL SAP CON ESPLOSIVI]
H. Holtbecker and M. Montagnani Brussels, EURATOM, Jun. 1964 21 p In ITALIAN; ENGLISH Summary Presented at the Conf. on Non-Fissionable Metals and Nucl. Reactors, Bologna, 16–18 Dec. 1963
(Contract EURATOM-040-61-9 ORGN)
(EUR-1818.I) Available from Belgian Am. Bank and Trust Co., N.Y., Account No. 22.186: 40 Belg. Fr.

A joint is to be fitted in the ORGEL reactor between the steel primary circuit and the SAP channel. The rolled joints are not entirely leakproof, and a weld must be found that is completely leakproof. Furthermore, in order to make possible some special channel designs, the SAP must be formed in order to reduce the diameter over a certain length. Preliminary welding tests were carried out on strips of the following materials: aluminum–aluminum, aluminum–stainless steel, SAP–aluminum, SAP–SAP, SAP–strainless steel. The possibility of obtaining, by means of an explosion, a reduction in diameter in a section of SAP 10% oxide tube ~90 mm in diameter was studied. Preliminary experiments showed the importance of the shape of the explosive charge and the need for a vacuum between tube and mandrel in order to avoid collision and ripples. Diameter reductions of between 5% and 20% were obtained. Author

N64-29793 Springfield Armory, Mass.
FACTORS INFLUENCING FRICTION OF PHOSPHATE COATINGS
Michael A. George 9 Apr. 1964 39 p refs
(SA-TR18-1084; AD-603320)

Coefficients of friction for the coatings were determined under static and dynamic conditions. The following factors influencing the coefficient of friction are considered: type of coating, lubrication, loading weight, surface roughness, crystalline structure, and velocity. The coefficients of friction for manganese phosphate coatings did not differ to any practical extent from the coefficients for zinc phosphate coatings. Lubrication is a significant factor on the coefficients of friction for phosphate coatings. The coefficient of friction was independent of the applied load. Velocity during dynamic testing, surface finish, and crystalline structure influenced the coefficient to a slight degree. Author

N64-29801 General Dynamics/Fort Worth, Tex. Nuclear Aerospace Research Facility

EFFECTS OF REACTOR RADIATION ON A CERAMIC-BONDED, A RESIN-BONDED, AND A METAL-MATRIX-BONDED SOLID-FILM LUBRICANT

R. H. Mc Daniel 31 Mar. 1964 26 p refs
(Contract AF 33(657)-7201)
(NARF-63-IIT; MR-N-306; AD-603442)

Three solid-film lubricant formulations—PbS + MoS_2 + B_2O_3, GD/FW Dynalube, and Almasol SFD-560—have been exposed to reactor radiation and tested for wear life on a Hohman A-6 wear tester. Rub shoes were of Rex AAA steel; load per shoe was 110 lb; and sliding speed was 128 ft/min. Substrate materials were T-1 tool steel for GD/FW Dynalube and Timken standard test races (T-54148-3-233) for the other two lubricants. Several test temperatures up to 1,150° F were employed. The solid-film lubricant specimens received an average radiation exposure of 1.7×10^{11} ergs/gm(C) of gammas and 3.7×10^{16} n/cm^2 (E > 2.9 Mev) of neutrons. Significant decreases in wear life occurred at 80° and 900° F for Dynalube, and at 900° F for SFD-560; PbS + MoS_2 + B_2O_3 showed no change; and SFD-560 improved markedly at 80° F. Author

N64-29810 Harry Diamond Labs., Washington, D.C.

ANALYSIS OF FRICTION AND ARMING TIME IN A T293-YPE SETBACK-LEAF SYSTEM

A. Hausner 10 Jun. 1964 36 p
(TR-1232; AD-602624)

An examination of frictional effects in a T293-type setback-leaf system was made. It was found by analog computation that a coefficient of friction function, $C_f = 0.275\ e^{-0.0023\dot{\theta}}$, where $\dot{\theta}$ is the instantaneous angular velocity of the leaf, could be used in analytic expressions to compute arming times in excellent agreement with the arming time of the leaf system obtained under ambient conditions in a centrifuge. ($\dot{\theta}$ is in units of rad/sec) Author

N64-29813 General Dynamics/Fort Worth, Tex. Nuclear Aerospace Research Facility

EFFECTS OF REACTOR RADIATION ON MIX-BIS (MIX-PHENOXYPHENOXY) BENZENE USED AS A LUBRICANT IN A HIGH-SPEED, HIGH-TEMPERATURE BEARING-RIG

W. M. Laney, R. H. Mc Daniel, M. R. Self, and J. H. Lewis 31 Mar. 1964 84 p refs
(Contract AF 33(657)-7201)
(NARF-63-IIT; FZK-9-193; AD-603444)

A radiation effects study has been conducted on mix-bis (mix-phenoxyphenoxy) benzene—Mixed 5P4E—used as a high-speed bearing lubricant at elevated temperatures. Bearing and bulk-oil test temperatures of 550°, 600°, and 700° F were employed, with axial bearing load of 200 lb at 60,000 rpm during control and test runs. It was concluded that a gamma dose of 2×10^{10} ergs/gm(C) plus associated neutrons is approaching the useful upper limit for Mixed 5P4E as a high-speed bearing lubricant at temperatures of from 550° to 600° F. At 700° F, this limit is decreased by approximately one order of magnitude. A 0.5% concentration of the antioxidant tetraphenyltin in Mixed 5P4E appeared to improve bearing-rig performance under irradiation. Author

N64-29819 United Aircraft Corp., Windsor Locks, Conn. Hamilton Standard Div.

ENHANCED MICRO-MODULE INTERCONNECTIONS (AN HERMETIC PACKAGING SYSTEM FOR THE INTEGRATION OF MICRO CIRCUITS) Third Quarterly Report, 1 Jan.–31 Mar. 1964

[1964] 56 p refs
(Contract DA-36-039-AMC-03620(E))
(HSER-2884; AD-602271)

Six engineering model design-enhanced micromodules were assembled and submitted to environmental testing—thermal shock, vibration, and mechanical shock. Engineering model design units were provided with microwafers with suitably shorted terminations, which permit weld resistance monitoring during vibration and establishment of weld degradation, if any, after environmental testing. Several 10-stage binary divider enhanced micromodules have been assembled up to the hermetic sealing step and found to be operative. Microwafers with either copper or nickel electroplated terminations have been used extensively for the assembly of engineering model design and functional modules. The previously assembled machines have been subjected to operational checkouts to establish compatibility with the overall process. The microwafer stack multiweld machine, as well as the can-header sealing machine, are in the process of being developed and integrated with the automatic wire programer. Author

N64-29844 General Electric Co., Auburn, N.Y. Rectifier Components Dept.

THE IMPROVEMENT OF PRODUCTION TECHNIQUES TO INCREASE THE RELIABILITY OF DIFFUSED SILICON CONTROLLED SWITCHES Quarterly Progress Report, 1 Apr.–30 Jun. 1964

J. N. Frank, A. Hishta, R. C. Rome, H. Wawrousek, and W. R. Comstock [1964] 39 p
(Contract DA-36-039-AMC-03619(E))
(QPR-4; AD-604734)

This report of a production engineering measure for the improvement of production techniques to increase the reliability of an all-diffused silicon controlled switch, of the 2N689 type, covers the work performed on the device package ultrasonic welding, the tests being conducted to determine the optimum tubulation weld schedules, the evaluation of completed high-speed low-voltage all-diffused devices, the experiments conducted to reestablish gold diffusion conditions, the comparison of material from four different n-type silicon crystals and their effect on pulse turnoff times, and the summary of blocking voltage step stress test data on the alloy-diffused device. Author

N64-29845 Union Carbide Corp., Cleveland, Ohio Kemet Dept.

PRODUCTION ENGINEERING MEASURE FOR IMPROVED RELIABILITY OF SOLID TANTALUM ELECTROLYTIC CAPACITORS Quarterly Progress Report, Apr. 1–Jun. 30, 1964

J. E. Riley [1964] 39 p
(Contract DA-36-039-AMC-03624(E))
(QPR-4; AD-604988)

A summary is presented herein of all experimental results and activities to date. Chronological plots are presented, showing that much progress has been made in improving capacitor yields, d.c. leakage current, and failure rates. Tabulated data are presented, giving pertinent results for every experiment performed thus far under the engineering studies. Other plots are included that depict phenomena associated with the formation and reformation processes. Author

N64-29851 Chance Vought Corp., Dallas, Tex. Vought Astronautics Div.
DIFFUSION COATING PROCESS FOR COLUMBIUM BASE ALLOYS Technical Documentary Report, Feb. 1961–Feb. 1962
William L. Aves, Jr., Gordon W. Bourland, Aleck B. Featherston, Brennan A. Forcht, and Kent P. O'Kelly Wright-Patterson AFB, Ohio, AF Mater. Lab., Jun. 1964 125 p refs
(Contract AF 33(616)-7896)
(ML-TDR-64-71; AD-603002)

This program was to improve and optimize coatings for columbium alloys, protective in air to 2,600° F for at least 10 hours. Process variables of two different silicide base coating systems (Si-Cr-Al and Si-Cr-B) applied by a two-step pack cementation process were optimized by statistical methods. Coatings were evaluated on D-31, C-103, Cb-1Zr (FS-80), and FS-82 columbium alloys. Oxidation resistance testing included furnace testing in moving air, sustained load thermal cycling, and propane torch and ram-jet tests. Tensile strength and bend properties of uncoated and coated alloys were evaluated at room and elevated temperatures. An analytical evaluation of these systems was conducted to characterize the coating components. In addition, oxidation tests in the range 1,000° to 2,000° F were conducted to determine "di-silicide pest" effects on the two systems. Author

N64-29888 Philips Gloeilampenfabrieken, N.V., Eindhoven (Netherlands) Philips Research Labs.
SPIRAL GROOVE BEARINGS Philips Research Reports Supplements, 1964, No. 2
E. A. Muijderman (Ph.D. Thesis) [1964] 210 p refs

This thesis deals with the calculation and use of bearings that transmit a force in the direction of the axis of rotation, and whose rubbing surfaces are provided with spiral grooves; these are called spiral groove thrust bearings. A pattern of inclined parallel grooves is discussed as a simplified model of a real spiral groove bearing, and a first approximate solution for the pressure and friction in such a bearing is derived from this model. The pressure buildup in the spiral groove is accurately calculated for a certain case with the aid of conformal mapping, and it is shown that a simple integration process may be used. The formulas obtained by simple integration are refined by taking the effect of the finite number of grooves (the "end effect") into account. The results obtained are used to derive accurate formulas for the mean radial pressure buildup, the load-carrying capacity, and the frictional torque to be expected with real bearings provided with spiral grooves in various ways. The limitations on the applicability of the formulas are discussed, and the theoretical results are compared with experiment. One very accurate set of measurements gave a discrepancy of less than 1.5% between theory and experiment. The use and fabrication of spiral groove bearings are discussed, particularly as applied to large constructions in which loads of from one to twenty tons are encountered. Author

N64-29890 Universidad Autonoma de San Luis Potosi (Mexico)
STUDY OF SOLID LUBRICATION [ESTUDIO SOBRE LUBRICACION]
Carlos Tellez Gallardo Aug. 1964 88 p refs In SPANISH

The principles of lubrication and the properties essential to a good lubricant are reviewed. Areas of study include these: (1) the properties of metal surfaces; (2) inertia; and (3) the reduction of friction by solid lubricants. D.E.R.

N64-29915 Mechanical Technology, Inc., Latham, N.Y.
EXPERIMENTS ON A PARTIAL ARC SELF-ACTING GAS JOURNAL BEARING
M. W. Eusepi Nov. 1963 34 p refs
(Contract Nonr-3730(00))
(MTI-23; MTI-63TR50; AD-425220)

Operational characteristics of a rotor when supported on self-acting, gas-lubricated journal bearings are reported. Experimental results for the evaluation of several parametric changes are noted. Some of these parameters included in the investigation are elevated ambient pressure up to 500 psig, clearance ratio, length-to-diameter ratio, bearing load, and bearing orientation. Author

N64-29926 Dayton U., Ohio Research Inst.
THE EVALUATION OF HIGH TEMPERATURE MATERIALS SYSTEMS WITH AN ARC-PLASMA-JET Technical Report, Feb. 1961–Jan. 1962
Howard E. Smith and John C. Wurst Wright-Patterson AFB, Ohio, AF Mater. Lab., Jun. 1964 192 p
(Contract AF 33(616)-7838)
(ML-TDR-64-73; AD-604418)

A small arc-plasma-jet was suitably modified and utilized for the evaluation and screening of high-temperature materials at heat flux levels ranging from 10 to 500 Btu/ft^2-sec. A "standard" evaluation procedure was employed to characterize a number of systems representing ablating, insulating, and heat sink type materials. Results of these tests are presented in terms of weight loss, density change, depth and volume of erosion, and front and back surface temperatures. A metallographic analysis of coating failures in the XLR-99 thrust chamber of the X-15 research aircraft and the subsequent development of a thermal shock test with the plasma-jet for sprayed ceramic coatings are discussed. The results of an extensive evaluation of protective coatings and the field test verification of these results are presented. Author

N64-29948 Western Electric Co., Inc., Winston-Salem, N.C.
INDUSTRIAL PREPAREDNESS STUDY: LACQUER FILM CAPACITORS Quarterly Progress Report, 25 Feb.–25 May 1964
J. B. Rawls [1964] 19 p
(Contract DA-36-039-SC-81268)
(QPR-21; AD-602094) OTS: $0.50

Effort was directed toward the completion of the polycarbonate capacitor pilot run production and testing program. The pilot run has successfully completed the salt fog, temperature and immersion cycling, moisture resistance, capacitance change with temperature, shock, and acceleration tests. The lot is now being tested on vibration. Author

N64-29977 Union Carbide Corp., Lawrenceburg, Tenn. Advanced Materials Lab.
RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS. VOLUME XXXIII: INVESTIGATION OF HOT-WORKED RECRYSTALLIZED GRAPHITES Technical Documentary Report, May 1961–Jan. 1963
J. H. Turner and M. B. Carter Wright-Patterson AFB, Ohio, AF Mater. Lab., Jun. 1964 64 p refs
(Contract AF 33(616)-6915)
(WADD-TR-61-72, Vol. XXXIII; AD-604683)

This report is concerned with fabrication and testing of hot-pressed (ZT) graphites made from several base stocks. Physical properties, with emphasis on porosimetry, are reported for varieties of molded and pressure-cured graphites both before and after hot pressing. A small amount of work was also

done with hot pressing of extruded graphites, powders, composites, and the surfaces of formed articles. The latter process is termed surface densification. Author

N64-30053 Westinghouse Electric Corp., Lima, Ohio Aerospace Electrical Div.
HIGH TEMPERATURE ALKALI METAL RESISTANT INSULATION
W. H. Snavely, R. E. Mc Vay, and R. E. Stapleton 10 Jul. 1964 70 p refs
(Contract AF 33(615)-1360)
(WAED-64-39-E; AD-602449) OTS: $3.00

Materials have been selected for 850° C potassium-vapor exposure. A transformer has been designed and selected as a test device to determine the combined effect of 600° C potassium vapor, fluctuating magnetic fields and high a.c. voltage (~1,000 vac) on insulators, potting compounds, magnetic materials, and electrical conductors. Potassium-vapor corrosion tests are in progress on the materials that will be used in the final test transformer. Ceramic-to-metal seal development is being studied extensively. Author

N64-30065 Atomic Energy Commission, Washington, D.C. Div. of Technical Information
ROTATING MACHINERY FOR GAS-COOLED REACTOR APPLICATION
May 1964 379 p refs Proc. of Meeting, Sponsored by Oak Ridge Natl. Lab., held at Gatlinburg, 4–6 Nov. 1963
(TID-7690) OTS: $4.50

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N64-30077 Battelle Memorial Inst., Columbus, Ohio
REPORT ON DEVELOPMENT OF ROLL-WELDED SANDWICH PANELS
[1964] 20 p ref Prepared Jointly with Douglas Aircraft Co.

A process for fabrication of production-size corrugated sandwich panels is described. The panels are bonded by rolling in a pack of mild steel with triangular bar inserts interspaced in the corrugations to provide a matrix material to support the structure during roll bonding. The steel matrix also permits forming into shaped sections with simple and compound curvature as low as 1T. After forming, the iron matrix is removed by acid leaching. For corrugation depths greater than about 4 inches, fresh acid is pumped to the bottom of the leach holes by a manifold device. The process also can be conducted to provide edge attachments and ports to be rolled into the panels. The present scale of development is up to 36- by 72-inch panels, but the maximum width and length of panels are limited only by rolling mill capacity. The quality of the roll-welded joint is excellent. Author

N64-30102* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EVALUATION OF SELECTED REFRACTORY OXIDE MATERIALS FOR USE IN HIGH-TEMPERATURE PEBBLE-BED WIND-TUNNEL HEAT EXCHANGERS
John D. Buckley and Bennie W. Cocke, Jr. Washington, NASA, Sep. 1964 32 p refs
(NASA-TN-D-2493) OTS: $0.75

Results are presented from laboratory tests and heat-exchanger experience comparing the properties of some refractory materials available for use in pebble-bed heat exchangers. Qualitative data on properties such as thermal-shock resistance and static load capacity at temperatures between 3,000° and 4,000° F are presented for several types of zirconia, for thoria, and for magnesia. Author

N64-30110 Dayton U., Ohio Research Inst.
THE EVALUATION OF HIGH TEMPERATURE MATERIALS. PART I: EVALUATION OF COATINGS FOR REFRACTORY ALLOYS. PART II: MATERIALS EVALUATION WITH AN ARC-PLASMA-JET Technical Report, Jan. 1962–Jun. 1963
John C. Wurst Wright-Patterson AFB, Ohio, AF Mater. Lab., Mar. 1964 227 p refs
(Contract AF 33(616)-7838)
(ML-TDR-64-62; AD-601638)

Analytical and experimental approaches are described, leading to the development of an orderly series of tests designed to characterize the oxidation behavior of refractory alloy coatings and to determine their influence upon the physical and mechanical properties of the base metal. The use of statistically designed experiments for creep-rupture testing and the application of the Weibull failure probability density function to furnace oxidation data are treated. The screening of 78 different high-temperature materials with an arc-plasma-jet testing facility is also described. A "standardized" procedure served as a general guide for these screening tests, although in several instances, the procedures were modified to study a particular aspect of a material's response to thermal loading. The systems evaluated fell into four general categories: ablative materials, impregnated porous ceramics, refractory composites, or sprayed ceramic coatings. Author

N64-30117 IIT Research Inst., Chicago, Ill.
DEVELOPMENT OF IMPROVED LINER FOR EXTRUSION BILLET CONTAINERS Final Report, 5 Jun. 1962–5 Jan. 1964
S. A. Spachner Wright-Patterson AFB, Ohio, AF Mater. Lab., May 1964 145 p
(Contract AF 33(657)-8784)
(ML-TDR-64-194; AD-604172)

Prototype extrusion liners of René 41 and Udimet 700 superalloys, and a variety of both Rokide-process and plasma-arc ceramic-coated liners, were produced and evaluated by extrusion of 3 1/2-in.-diam SAE 4340 steel billets at 2,000° F and extrusion of TZM alloy billets at 3,300° to 3,600° F, using a 1,000-ton capacity, high-speed hydraulic press. Compositions of fiber-metal reinforced ceramic materials specially designed for liner application, were produced and evaluated by extrusion-screening tests. A Rokide-process stabilized zirconia ceramic-coated liner withstood TZM alloy extrusion at 3,450° F. Plasma-arc coatings of stabilized zirconia and gradated alumina–nickel, and cast Udimet 700 alloy, proved satisfactory for steel extrusion at 2,000° F. Preliminary evaluation indicated that glass lubricants were unnecessary when extruding steel billets in a gradated alumina–nickel ceramic-coated extrusion liner. Fiber-metal reinforced ceramic mixtures of $72Al_2O_3$-28Mo and $59.5Al_2O_3$-40.5Mo proved capable of withstanding billet temperatures of 3,450° F. Author

N64-30122 Virginia U., Charlottesville Research Labs. For the Engineering Sciences
RESEARCH INVESTIGATION OF MAGNETIC AND ELECTRIC FORCES FOR ROTATING SHAFT SUSPENSION Technical Quarterly Progress Report, Mar.–May 1964
May 1964 21 p refs
(Contract AF 33(657)-8364)
(EMI-3421-111-64U; AD-601199)

Certain theoretical results that have been obtained in the search for ways to damp a resonant magnetic support are presented, together with some measure of experimental verification. The radially active magnetic-support technology is now ready for the design extrapolation, which is the objective of this program. In addition, positive integral feedback was investigated as a means for overcoming the severe limits imposed on the bandwidth over which compensation may be effected by the use of magnetic currents. I.v.L.

N64-30146 Allegheny Ludlum Steel Corp., Brackenridge, Pa. Research Center
TANTALUM ALLOY TUBING DEVELOPMENT PROGRAM Third Interim Technical Engineering Report, 15 Jan.–15 Apr. 1964
F. S. Turner Wright-Patterson AFB, Ohio, Res. and Tech. Div., Apr. 1964 15 p refs
(Contract AF 33(657)-11261)
(RTD-8-109-(III); AD-438777)

The development of manufacturing methods for the production of various sizes of tantalum-alloy tubing having improved high-strength and corrosion-resistance characteristics is discussed. Activities dealing with material procurement and with tooling design and manufacture are outlined. P.V.E.

N64-30147 General Motors Corp., Kokomo, Ind. Delco-Radio Div.
PRODUCTION ENGINEERING MEASURE: 2N1358A TRANSISTOR Final Engineering Report (Section II and III), Apr. 30, 1962–Apr. 30, 1964
G. Wagner et al [1964] 190 p refs
(Contract DA-36-039-SC-86725)
(AD-603363)

Pertinent process specifications relating to the PEM program are discussed. These specifications are as follows: (1) describe the authorized procedure for sorting wafers into thickness categories, both before and after etching; (2) outline the authorized procedure for washing wafers after final measure to obtain the surface condition required for alloying; (3) outline the authorized procedure for slicing single-crystal germanium slabs or chunks into bars on the microslicer; (4) cover the operation of the furnace in which transistor elements are alloyed; (5) describe the procedure for the cleaning of bases prior to mounting and of the caps prior to coding; (6) describe the authorized procedure for assembling the mounting-base assembly; (7) outline the authorized procedure for hydrogen mounting of the cold-weld round-base units; (8) describe the authorized procedure for data coding the encapsulated unit, and for placing the insulator in the location pin, both in the same operation; and (9) describe the authorized procedure for the baking of caps and the preparation and loading of dessicant into the cap. In addition, the reliability and quality-control policy and procedure manual are included. I.v.L.

N64-30153 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
LUBRICATION OF TURBOJET AND TURBOPROP ENGINES
S. Szczinski and M. Lyzwinski 11 Jul. 1964 14 p Transl. into ENGLISH from Wojskowy Przeglad Lotniczy (Warsaw), no. 3, 1963 p 47–55
(FTD-TT-64-143/1+2; AD-603390)

Schematic drawings are presented of closed, open, and mixed lubrication systems. Descriptions are given of the basic components of specific oil systems for turbojet and turboprop engines. Suggestions are offered as to the proper care and maintenance of the oil systems used. A.W.

N64-30161 Boeing Co., Seattle, Wash. Aero-Space Div.
INVESTIGATION OF SELF-ALIGNING BEARING MOUNTINGS FOR SPACE OPERATION Quarterly Progress Report, Jun. 1–Sep. 1, 1963
D. T. Jones, R. A. Kvinge, F. Schenk, and J. Van Wyk Sep. 1963 24 p refs
(Contract AF 33(657)-10422)
(QRP-2; AD-439856) OTS: $2.60

Fabrication was initiated on two mounting concepts studied previously. Lubricants were selected for use in −100° to 2,500°F temperature and 10^{-9} torr vacuum environments. Fabrication of in-air test equipment was completed, and vacuum test equipment fabrication is nearing completion. Author

18 MATERIALS, METALLIC

Includes cermets; mechanical and physical properties of alloys and metals; and metallurgy. *For related information see*: 07 Chemistry; 17 Machine Elements and Processes; 19 Materials, Nonmetallic; 33 Stresses and Loads; and 34 Structural Design.

N64-29035 Joint Publications Research Service, Washington, D.C.
MECHANICAL PROPERTIES OF CAST METAL
22 Jul. 1964 136 p refs Transl. into ENGLISH from Mekhan. Svoystva Litogo Metalla, Tr. Vos'mogo Soveshch. Po Teorii Liteynikh Protsessov (Moscow), 1963 p 141–152, 158–162, 172–176, 217–258, 265–274, 287–296
(JPRS-25537; TT-64-31809) OTS: $2.75

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9. INFLUENCE OF TECHNOLOGICAL FACTORS ON THE MECHANICAL PROPERTIES OF HEAT-RESISTANT STEEL NOT CONTAINING NICKEL I. M. Yazovskikh, I. M. Gorbachev, and Yu. A. Bukin p 74–84 (See N64-29044 21-18)

10. CAST HEAT-RESISTANT STEEL FOR BLADE ASSEMBLIES OF TURBOCOMPRESSORS V. M. Kulayev p 85–88 (See N64-29045 21–18)

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12. MECHANICAL PROPERTIES OF ALUMINUM-MAGNESIUM ALLOYS M. F. Nikitina p 102–111 ref (See N64-29047 21-18)

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15. INCREASING THE STRENGTH OF ML5 ALLOY CASTINGS BY CHANGING THE HEAT-TREATMENT REGIME B. B. Tarnetskiy p 125–132 refs (See N64-29050 21-18)

N64-29036 Joint Publications Research Service, Washington, D.C.
ELECTROSLAG CASTING AND ITS PROSPECTIVE USE IN FOUNDRY PRODUCTION
B. Ye. Paton, B. I. Medovar, and Yu. V. Latash *In its* Mech. Properties of Cast Metal 22 Jul. 1964 p 1–13 (See N64-29035 21-18) OTS: $2.75

The use of electroslag remelting (EShP) of consumable electrodes in metallic force-cooled crystallizers to increase the quality of a cast metal is discussed. One advantage of EShP is that exceptionally high density material is obtained from the process. The EShP process, besides being used to obtain ingots, can also be used to obtain high-quality castings, of relatively simple form, from alloy steels. P.V.E.

N64-29037 Joint Publications Research Service, Washington, D.C.
INVESTIGATION OF THE PROPERTIES OF HIGHLY WELDABLE CASTINGS OF HIGH-STRENGTH STEELS
B. B. Gulyayev, S. A. Stepanov, P. Ye. Alekseyev, and M. M. Sandomirskiy *In its* Mech. Properties of Cast Metal 22 Jul. 1964 p 14–21 (See N64-29035 21-18) OTS: $2.75

Results of research to find new types of high-strength steel exhibiting good weldability and having improved mechanical properties are discussed. P.V.E.

N64-29038 Joint Publications Research Service, Washington, D.C.
MECHANICAL PROPERTIES OF CAST LOW-ALLOY MANGANESE STEEL
V. N. Polisadov *In its* Mech. Properties of Cast Metal 22 Jul. 1964 p 22–28 (See N64-29035 21-18) OTS: $2.75

The use of a complex reducing agent (60% to 65% Mn, 12% to 15% SiO_2, and 5% to 7% Al) to improve the production parameters of low-alloy manganese steels is discussed. Cerium, lanthanum, or mischmetal, and boron were introduced into the

liquid metal as modifying admixtures. The experimental smeltings were carried out in induction steel smelting furnaces under laboratory conditions, and in 1.5-ton electric-arc furnaces under industrial conditions. Steels of peritectic composition (0.15 to 0.2% S), containing up to 2.7% to 3.0% manganese, were obtained. During experiments on hardenability by the method of butt hardening, the following depths of 50% martensite zones were obtained: (1) on samples of carbon steel with a content of 0.3% C—a distance of 5 to 6 mm from the hardened face; (2) on samples of low-alloy manganese steels with a content of 1.54% Mn—a distance of 7 to 8 mm from the hardened face; and (3) on samples of low-alloy manganese steels with a content of approximately 0.005% boron—in a zone at a distance of 20 to 21 mm from the hardened face. P.V.E.

N64-29039 Joint Publications Research Service, Washington, D.C.

EFFECT OF TECHNOLOGICAL FACTORS ON PROPERTY INCREASE OF CAST STAINLESS NONMAGNETIC STEEL

O. N. Magnitskiy *In its* Mech. Properties of Cast Metal 22 Jul. 1964 p 29–36 (See N64-29035 21-18) OTS: $2.75

The effects of exposure to air on the ductility and plasticity of stainless steel were investigated. Methods for protecting the liquid metal during casting procedures are discussed. P.V.E.

N64-29040 Joint Publications Research Service, Washington, D.C.

EFFECT OF CASTING MOLD ON THE MECHANICAL PROPERTIES OF REFRACTORY METALS

A. A. Demidova and B. B. Gulyayev *In its* Mech. Properties of Cast Metal 22 Jul. 1964 p 37–45 (See N64-29035 21-18) OTS: $2.75

Results obtained in determining the extent of contamination (of the casting materials) by the reaction products of smelted titanium and chromium with various casting materials are presented. The effects of these contaminates on the mechanical properties of the cast metals are also discussed. The metal billets were placed in the experimental molds, consisting of various refractory materials, and were melted by induction heating in a vacuum or protective atmosphere. Experimental molds used in the investigation consisted of pulverized quartz, titanium dioxide, synthetic corundum, cerium dioxide, fused zirconium dioxide, magnesite, zircon, and graphite. P.V.E.

N64-29041 Joint Publications Research Service, Washington, D.C.

INFLUENCE OF TECHNOLOGICAL PROCESSES ON THE PROPERTIES OF REFRACTORY METALS IN CASTING

E. Ya. Kukkonen, G. A. Kaplunovskiy, O. N. Magnitskiy, and B. B. Gulyayev *In its* Mech. Properties of Cast Metal 22 Jul. 1964 p 46–55 refs (See N64-29035 21-18) OTS: $2.75

Discussed is the effect that the following procedures and parameters have on the mechanical properties of cast titanium- and molybdenum-based alloys: methods of preparation of the liquid metal, smelting conditions, casting parameters, and the properties of the casting metals themselves. P.V.E.

N64-29042 Joint Publications Research Services, Washington, D.C.

INVESTIGATION OF THE PHYSICAL-MECHANICAL PROPERTIES OF IRON AND NICKEL BASED ALLOYS

V. M. Stepanov and V. M. Korolev *In its* Mech. Properties of Cast Metal 22 Jul. 1964 p 56–64 (See N64-29035 21-18) OTS: $2.75

The results of the investigation of the physical-mechanical properties of structural steels of types 35KhGSL, 27KhGSNML and a heat-resistant nickel-based alloy are presented. The results of the investigation show that the effect of the mold temperature on the mechanical properties must be examined in close connection with the shape and dimensions of the billets for control samples and castings and with the wall thicknesses. At an increase in the mold temperature, the mechanical properties of samples of individual billets are improved, but for trefoil samples considerably larger in cross-section, the properties deteriorate. Thus, at an increase in the mold temperature from 20° to 800° C, the plasticity of 35KhGSL and 27KhGSNML steels in the individual billets is increased up to 30%, and in trefoil billets it is decreased to 50%. An analogous change in the properties is also observed in nickel-based alloys. Author

N64-29043 Joint Publications Research Service, Washington, D.C.

EFFECT OF CERIUM ON THE MECHANICAL PROPERTIES OF CAST HEAT-RESISTANT 15KhIMIFL STEEL

N. S. Kreshchanovskiy and V. R. azarenko *In its* Mech. Properties of Cast Metal 22 Jul. 1964 p 66–73 (See N64-29035 21-18) OTS: $2.75

An investigation into the possibility of improving the plastic properties and impact toughness of steel by means of modifying it by cerium is discussed. Cerium was used in the form of mischmetal and ferrocerium. The mischmetal and ferrocerium were introduced directly into the liquid steel in the furnace, into the ladle, and into the stream of metal during teeming of the molds. The metal, modified by cerium, was investigated for its gas content, nonmetallic inclusions, harmful impurities, microstructure and macrostructure, mechanical properties, and stress-rupture strength. Addition of cerium had a positive influence both on the strength and on the plastic properties of the steel; the best properties were obtained with its addition into the steel in a 0.1% to 0.15% quantity. Upon introduction of 0.15% cerium, the impact toughness of steel from industrial smeltings more than tripled; the specific contraction increased by a factor of 1.5 to 1.8; and the specific elongation increased by a factor of 1.5. P.V.E.

N64-29044 Joint Publications Research Service, Washington, D.C.

INFLUENCE OF TECHNOLOGICAL FACTORS ON THE MECHANICAL PROPERTIES OF HEAT-RESISTANT STEEL NOT CONTAINING NICKEL

I. M. Yazovskikh, I. M. Gorbachev, and Yu. A. Bukin *In its* Mech. Properties of Cast Metal 22 Jul. 1964 p 74–84 (See N64-29035 21-18) OTS: $2.75

A study of the properties and the determination of the possibility of application for castings of furnace equipment (pans, hearths, plates, etc.) of chromium–manganese steel not containing nickel is discussed. The composition of the investigated steels was 15% to 17% Mn, 16% to 17% Cr, 0.30% to 0.60% Ti, 0.35% to 0.85% C, and 1.50% to 2.50% Si. The investigation showed that the best complex of mechanical properties is possessed by steel that has not been subjected to heat treatment, but has been reduced in a ladle by 0.2% aluminum, and teemed at 1,500° C, with the following composition: 0.55% to 0.65% C, 2.0% to 2.5% Si, 15% to 17% Mn, 15% to 17% Cr, 0.30% to 0.60% Ti, and 0.014% S. P.V.E.

N64-29045 Joint Publications Research Service, Washington, D.C.

CAST HEAT-RESISTANT STEEL FOR BLADE ASSEMBLIES OF TURBOCOMPRESSORS

V. M. Kulayev *In its* Mech. Properties of Cast Metal 22 Jul. 1964 p 85–89 (See N64-29035 21-18) OTS: $2.75

The processes used in casting an impeller for a small-size turbocompressor are outlined. The impeller consists of 19 blades. The height of the hub is 75 mm, the maximum external diameter is 330 mm, and the average length of the blades is 68 mm. A smelting process was used to cast the impeller from heat-resistant chromium–nickel–titanium steel with a larger-than-average manganese content. P.V.E.

N64-29046 Joint Publications Research Service, Washington, D.C.

MECHANICAL PROPERTIES OF HIGH-ALLOY STEELS AT NORMAL AND INCREASED TEMPERATURES

I. I. Goryunov *In its* Mech. Properties of Cast Metal 22 Jul. 1964 p 90–101 (See N64-29035 21-18) OTS: $2.75

The effect of alloying additives of nickel, vanadium, niobium, copper, and other elements on the mechanical and corrosive properties of stainless, 13% chromium, steels at normal temperatures is discussed. The mechanical properties of high-alloy steels, as a function of the method of casting manufacture, were also investigated. P.V.E.

N64-29047 Joint Publications Research Service, Washington, D.C.

MECHANICAL PROPERTIES OF ALUMINUM–MAGNESIUM ALLOYS

M. F. Nikitina *In its* Mech. Properties of Cast Metal 22 Jul. 1964 p 102–111 ref (See N64-29035 21-18) OTS: $2.75

The following are discussed with respect to aluminum–magnesium alloys: (1) their treatment in the liquid state in order to reduce grain size and to decrease gas porosity on subsequent crystallization; (2) reduction of alloy oxidizability, both during smelting and during pouring into sand molds; and (3) effect of heat-treatment conditions on their mechanical properties. P.V.E.

N64-29048 Joint Publications Research Service, Washington, D.C.

A1158K SECONDARY ALUMINUM ALLOYS FOR PRESSURE CASTING

Ye. A. Lebedev *In its* Mech. Properties of Cast Metal 22 Jul. 1964 p 112–117 (See N64-29035 21-18) OTS: $2.75

A new method for complex determination of the casting and mechanical properties of alloys used for pressure casting is outlined. In the method, a special die is used that produces specimens for mechanical-strength testing, for fluidity measurements, for measurement of airtightness, and for determining the tendency toward hot cracking. Results of tests on several alloys are included. P.V.E.

N64-29049 Joint Publications Research Service, Washington, D.C.

EFFECT OF VIBRATION ON THE PROPERTIES OF CAST METAL

G. F. Balandin and Yu. P. Yakovlev *In its* Mech. Properties of Cast Metal 22 Jul. 1964 p 118–124 (See N64-29035 21-18) OTS: $2.75

A casting method, using vibrated teeming devices, developed for use in casting metals is discussed. In the process, liquid-metal subjected to vibration is supplied to some pouring device (funnel, trough, etc.). The vibrations are applied to the metal only while it is in the filling device. On the basis of an investigation into the effect of vibration on molded alloys, it was established that both with vibration of the mold and with vibration of the pouring device, grain-size reduction occurred as a result of increases in the crystallization centers appearing in solid phase fragments. P.V.E.

N64-29050 Joint Publications Research Service, Washington, D.C.

INCREASING THE STRENGTH OF ML5 ALLOY CASTINGS BY CHANGING THE HEAT-TREATMENT REGIME

B. B. Tarnetskiy *In its* Mech. Properties of Cast Metal 22 Jul. 1964 p 125–132 refs (See N64-29039 21-18) OTS: $2.75

A three-step heating process developed for heat treatment of alloy castings and consisting of the following steps is discussed: (1) loading of the castings into the furnace at temperatures not exceeding 150° to 200° C; (2) raising the temperature to 340° ±4° C and holding for 2 hours; (3) raising the temperature to 370° ±4° C and holding a minimum of 1 hour; and (4) raising the temperature over at least a 2-hour period to 425° ±4° C and holding for 8 to 10 hours. A comparison is made between the mechanical properties of castings produced under the three-step process and of those produced under the usual one-step heat-treatment process. The results of the comparison are discussed. P.V.E.

N64-29195* Battelle Memorial Inst., Columbus, Ohio

INVESTIGATION OF MECHANICAL PROPERTIES OF CHROMIUM, CHROMIUM-RHENIUM, AND DERIVED ALLOYS Quarterly Progress Report No. 17

A. Gilbert and C. N. Reid 31 Jun. 1964 12 p refs
(Contract NASw-101)
(NASA-CR-58288) OTS: $1.60 ph

The crystallography of slip and cleavage in Mo-35Re crystals was studied. Twinning was completely suppressed, and slip on {112} planes was observed at 415° and 28° C in a crystal with its longitudinal axis near to ⟨001⟩. Slip occurred on systems that were almost ideally oriented for the maximum shear stress. Brittle cleavage fractures of similar crystals were performed by impact at a temperature near 80° K. The fracture propagated largely along {112}-type twin-matrix boundaries. Author

N64-29217* Syracuse U. Research Inst., N.Y.

ADHESION BETWEEN ATOMICALLY PURE METALLIC SURFACES, PART III Annual Report (Final), 1963–1964

Douglas V. Keller, Jr., Wilbur Mitchell Franklin, Jr., and Daniel Hauser Jul. 1964 142 p refs
(Grant NsG-483)
(NASA-CR-58714; SURI-MET-1100-647A) OTS: $11.00 ph

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1. SURFACE ENERGY OF SOLID SILVER, PART I W. M. Franklin, Jr. 104 p refs (See N64-29218 21-18)

2. FORCES OF ADHESION BETWEEN CLEAN METALLIC SOLIDS, PART II D. Hauser 35 p refs (See N64-29219 21-18)

N64-29218* Syracuse U. Research Inst., N.Y.

SURFACE ENERGY OF SOLID SILVER, PART I

Wilbur Mitchell Franklin, Jr. *In its* Adhesion between Atomically Pure Metallic Surfaces, Pt. III Jul. 1964 104 p refs (See N64-29217 21-18) OTS: $11.00 ph

A three-dimensional atomic model of solid surfaces is developed, and the origins of surface stress are explained. It is shown how the strain energy in solid surfaces can be incorporated into the equilibrium thermodynamic equations of surfaces. A relation between gradients of surface quantities

is derived. A new, direct experimental approach to the determination of surface energy of atomically clean surfaces was developed. The technique involves the evaporation in ultrahigh vacuum of a solid sample to form a thin film of very large surface area. Author

N64-29219* Syracuse U. Research Inst., N.Y.
FORCES OF ADHESION BETWEEN CLEAN METALLIC SOLIDS, PART II
Daniel Hauser *In its* Adhesion between Atomically Pure Metallic Surfaces, Pt. III Jul. 1964 35 p refs (See N64-29217 21-18) OTS: $11.00 ph

An atomistic approach to the problem of solid adhesion suggests a mechanism for metallic adhesion in which the application of either normal or tangential forces is unnecessary, provided the surfaces are atomically clean when they are brought into contact. An analytical balance for measuring adhesion forces between clean surfaces in ultrahigh vacuum was designed, constructed, and tested. R.L.K.

N64-29233 Marquardt Corp., Van Nuys, Calif.
CALENDAR YEAR 1963 RAMJET TECHNOLOGY PROGRAM. VOLUME 10: HIGH TEMPERATURE COATED TUNGSTEN STRUCTURES Final Summary Technical Report, 25 Jan. 1963–31 Jan. 1964
J. K. Totten Jun. 1964 31 p refs
(Contract AF 33(657)-12146)
(Rept.-25116, Vol. 10; AD-602049) OTS: $1.00

Material systems of binary, ternary, and quaternary alloys were synthesized in an arc-melting furnace and then screened for oxidation resistance using an oxyacetylene torch. This resulted in the development of a binary hafnium–tantalum alloy that withstood temperatures well above 3,460° R, under oxidizing conditions. The oxide grown from the base alloy was well-bonded, thermal shock resistant, and dense. A feasibility study on the coating of the test specimens was accomplished by plasma-arc spraying and slurry coating the alloy powders onto tungsten and 90% tantalum–10% tungsten substrates of various configurations. This work has demonstrated the feasibility of utilizing this very promising material system as a coating for oxidation protective refractory metals. Author

N64-29310 Airesearch Mfg. Co., Phoenix, Ariz.
MATERIALS INVESTIGATION, SPUR PROGRAM. PART IV: FATIGUE EVALUATION OF Cb + 1 W/O Zr
R. Salley and E. Kovacevich Feb. 1964 17 p
(Contract AF 33(657)-8954)
(ASD-TDR-63-270, Pt. IV; AD-429932)

The results of experimental investigations to evaluate the cantilever fatigue properties of Cb + 1 w/o Zr are presented. Tests were conducted with specimens in 800° F liquid potassium and in 1,600° F liquid lithium to determine what effect, if any, these alkali metals would have on the fatigue properties of this alloy. The tests resulted in no serious contamination of the test material, and endurance limits for the test conditions were established. Author

N64-29336* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
ANALYSIS OF BONDING MECHANISM BETWEEN PLASMA-SPRAYED TUNGSTEN AND A STAINLESS STEEL SUBSTRATE
William A. Spitzig and Salvatore J. Grisaffe Washington, NASA, Sep. 1964 17 p refs
(NASA-TN-D-2461) OTS: $0.50

Experimental results show that alloy bonds can be formed between tungsten particles and a 304 stainless steel substrate during the plasma-spraying process. A heat-transfer analysis has demonstrated the feasibility of raising the temperature of a 304 stainless steel substrate directly beneath a tungsten particle to temperatures near the melting range of the substrate and thereby giving rise to high diffusion rates, which promote bonding. This local temperature rise occurs when the tungsten particle gives up its energy, obtained as a result of traveling in the plasma stream, to a small region in the stainless steel directly beneath the particle. This region is raised to temperatures near its melting range and cooled to around 500° F in approximately 10^{-5} second. Author

N64-29410 Experimental Inst. of Light Metals, Milan (Italy)
RESISTOMETRIC INVESTIGATION OF PRE-PRECIPITATION IN THE Al-Mg 5% ALLOY Final Report, 1 Jan.–31 Dec. 1963
T. Federighi and S. Ceresara 28 Jan. 1964 39 p refs
(Contract DA-91-591-EUC-2767)
(Rept.-13.177/6401.104; AD-602103) OTS: $1.25

The pre-precipitation process in the supersaturated Al 5.1 at.% Mg alloy was investigated by means of electrical resistivity measurements performed at liquid-nitrogen temperature (−195° C). A tentative picture of the pre-precipitation phenomenon in Al-Mg alloys is suggested. The picture is based on two fundamental points: (1) the existence of a strong interaction between vacancies and Mg cluster; and (2) the condensation, during or immediately after quenching, of a large fraction of vacancies into small submicroscopic vacancy-rich clusters or stacking faults. It is shown that it is possible to account for the shape of isothermal curves, for the scarce effect of quenching temperature on the aging curves, and for easy dissolution of solute clusters. P.V.E

N64-29510* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
INVESTIGATION OF THERMAL SHOCK RESISTANCE OF ZIRCONIA WITH METAL ADDITIONS
Alan Arias Washington, NASA, Sep. 1964 76 p refs
(NASA-TN-D-2464) OTS: $2.00

The thermal shock resistance of zirconia with metal additions and, in particular, that of zirconia with 15 mole % titanium was determined by quenching disks with thermally insulated faces under various heat-transfer conditions. Values of the thermal shock parameter ΔT were obtained by quenching from above and from below the transformation temperature of zirconia. The thermal shock resistance of calcia-stabilized zirconia was also determined for comparison purposes. For quenches from below the transformation temperature range, the thermal shock resistance of zirconia–titanium compositions was much better than that of calcia-stabilized zirconia, but for quenches from above the transformation range, it was slightly inferior. The parameters entering into the thermal shock equation were investigated individually—most of them as functions of temperature—in order to identify those responsible for the improved thermal shock resistance. Author

N64-29537* Rice U., Houston, Tex.
THE TEMPERATURE DEPENDENCE OF THE MICROYIELD POINTS IN PRESTRAINED MAGNESIUM SINGLE CRYSTALS
J. M. Roberts and D. E. Hartman Repr. from Trans. Met. Soc. AIME, v. 230, Aug. 1964 p 1125–1133 refs
(Grant NsG-6-59)

A detailed study of the temperature dependence of the critical stress, τ_B, necessary to cause a damping loss of 1.41×10^{-6} g mm per mm^3 in prestrained magnesium single crystals has been carried out in the temperature range 82° to 320° K. The τ_B is found to be linearly related to the reciprocal of the absolute temperature in this temperature range. The temperature dependence of the anelastic limit, τ_A, defined as the stress necessary to form open unidirectional stress-cycle damping loops, has been measured between 82° to 320° K. τ_A is found to be independent of temperature in this range. The temperature and stress dependence of the effective activation volume (V_{eff}) has been measured in the damping-loop region in prestrained magnesium single crystals. The data suggest that V_{eff}/kT is approximately constant, equal to $\cong$ 4.5 sq mm per g in the temperature range 130° to 298° K, and that V_{eff} is almost independent of stress at stress levels greater than $10 g/mm^2$. Author

N64-29578 Naval Applied Science Lab., Brooklyn, N.Y. Material Sciences Div.
REPORT OF INVESTIGATION OF CAVITATION EROSION RESISTANCE AND RELATED PROPERTIES OF POTENTIAL HYDROFOIL STRUCTURAL ALLOYS AND COATINGS Technical Memorandum No. 2
[1963] 24 p refs
(USNASL-9110-PY-1; AD-428145)

This report describes investigations of the cavitation-erosion resistance, both magnetorestrictive and rotating, of potential hydrofoil structural alloys and coatings. The alloys were of the following types: nickel alloys, high-alloy steels, titanium alloys, copper alloys, and low-alloy steels. The coatings were neoprene and polyurethane. The relationship between resistance to cavitation erosion and other mechanical and chemical properties of these materials is discussed. Tabular data on the following are presented: (1) the effect of liquid corrosivity in cavitation-erosion rate; (2) the mechanical properties of the test materials; (3) corrosion and cavitation-erosion properties of the test materials; and (4) the order of merit of metallic materials on the basis of cavitation erosion in sea water. I.v.L.

N64-29639 Wien U. (Austria)
INFILTRATED TANTALUM, NIOBIUM AND GRAPHITE COMPOUND MATERIALS Final Technical Report, 1 Nov. 1963–1 Feb. 1964
Richard Kieffer [1964] 38 p
(Contract DA-91-591-EUC-2814)
(AD-442530)

Infiltration tests with melted and disolved salts of the metals Mo, W, Nb, Ta, and Re show that 30 to 70 weight percent of the metals Mo, W, and Re, and the same quantity of the monocarbides of Nb and Ta can be introduced into a graphite skeleton, thus increasing the compressive strength (skeleton amidst a skeleton). The infiltration of these graphite compound materials with Cu or Ag succeeds only at the surface. A complete infiltration in pressure bottles seems to be possible with very porous graphite of coarse grain structure. The Cu-Si and, especially, Mo-Si alloys are wetting the compound material at higher temperatures and lead to superficial infiltrations, which may serve as a basis for special coatings. Author

N64-29660 Naval Research Lab., Washington, D.C.
IRRADIATION EFFECTS ON STRUCTURAL MATERIALS Quarterly Progress Report, 1 Nov. 1962–31 Jan. 1963
L. E. Steele, J. R. Hawthorne, and H. E. Watson 15 Feb. 1963 35 p refs
(NRL-MR-1393; AD-600303) OTS: $2.00

Progress is reported on the study of the effects of neutron irradiation upon the properties of structural materials. This report describes new data on the effects of several experimental variables on the observed recovery of properties of irradiated steels, the notch ductility of the SL-1 reactor pressure vessel, results of neutron environmental survey of the SM-1A reactor, and new equipment and procedures for in-reactor experimentation and for postirradiation evaluation of irradiated materials. Author

N64-29705* Southwest Research Inst., San Antonio, Tex.
DEVELOPMENT OF WELDING TECHNIQUES AND FILLER METALS FOR HIGH STRENGTH ALUMINUM ALLOYS Progress Report No. 33, 1 Jan.–31 Mar. 1964
Norris G. Lenamond, José Mc Donald, and Kenneth K. Speirs 15 Apr. 1964 86 p refs
(Contract NAS8-1529; Proj. 1063-7)
(NASA-CR-58536; QR-9) OTS: $8.10 ph

The mechanical properties of high-strength, thick gage 2219 aluminum–copper alloy weldments are being investigated. This investigation includes both uniaxial and biaxial loading conditions. The failure mechanism in uniaxial and biaxial testing is also being studied. In addition, weld zone metallurgical phases are being studied and evaluated as to their influence on the mechanical properties. Three 3/4-in.-thick test panels have been satisfactorily hydraulically bulged. Two of these plates have been examined metallographically. An analysis of strain in discrete locations across transverse weld tensile specimens has been made. These tests show that 57.1% of the strain in the commonly used 2-in. gage lengths occur in the weld deposit, 8.4% in the HAZ, and 12.9% in the parent metal. Author

N64-29709* Massachusetts Inst. of Tech., Cambridge
RESEARCH ON A SUPERCONDUCTING NIOBIUM-THORIUM ALLOY Summary Report I
H. E. Cline, R. M. Rose, and J. Wulff 12 Jul. 1964 60 p refs
(Contract NAS3-2590)
(NASA-CR-54103) OTS: $5.60 ph

Large ingot specimens of the Nb-Th eutectic alloy were processed into wire. The expected high field properties were not produced. The Th-Nb-Ti ternary alloy exhibited essentially the properties of the Nb-Ti solid solution. Mechanical composites of highly regular geometry were constructed, consisting of Nb wires in a Cu matrix, and Nb-Ti wires in a Nb matrix. No enhancement was observed for the Nb-Cu composite, for filament size down to 1,000 A. For 1,000 to 100 A sizes the critical field decreased. The (Nb-Ti)-Nb composite had the properties of very highly cold-worked Nb-Ti. Author

N64-29749 Brookhaven National Lab., Upton, N.Y.
HIGH-TEMPERATURE LIQUID-METAL TECHNOLOGY REVIEW, VOLUME 1, NUMBER 2, APRIL 1963 A Bimonthly Technical Progress Review
O. E. Dwyer, ed. Apr. 1963 47 p refs
(BNL-801-(PR-2)) OTS: $1.25

A review is presented that covers all phases of liquid-metal technology pertinent to the space program, including materials development, corrosion, heat transfer, fluid dynamics, instrumentation, component development, physical properties, and power systems. I.v.L.

N64-29755 IIT Research Inst., Chicago, Ill.
ALLOYING CHARACTERISTICS OF THE RARE EARTH ELEMENTS WITH THE TRANSITION ELEMENTS Final Report, Mar. 15, 1962–Apr. 30, 1964
Rodney P. Elliott Washington, AEC, 30 Apr. 1964 35 p refs
(Contract AT(11-1)-578)
(IITRI-578P19-13) OTS: $0.75

The alloying characteristics of the rare-earth elements with the transition metals undergo a radical change as the atomic number of the transition series increases—transition elements in Groups IVa, Va, and VIa are immiscible with the rare earths, whereas elements of Groups VIIa, and VIIIa, VIIIb, and VIIIc form many compounds. Since this cannot be correlated with a size effect, a reasonable explanation for this behavior is a valency or electronegativity effect. Those binary systems forming compounds form Laves phases, which can exist in one of three related crystal structure types—$MgCu_2$, $MgZn_2$, or $MgNi_2$. The specific Laves-type crystal structure can be related to the average free electron concentration, a phenomenon that has been used to calculate electronic valency of the transition elements. A compilation of the known Laves-type phases occurring between rare-earth elements and transition metals supports the hypothesis that the valency effect is operative. Author

N64-29760 Iowa State U. of Science and Tech., Ames Ames Lab.
TENSILE TEST TO FIND ENDURANCE LIMIT OF STRAIN-AGEABLE METALS
Knud Pedersen and Glenn Murphy Jul. 1964 18 p
(Contract W-7405-ENG-82)
(IS-929) OTS: $0.50

Fatigue curves for steel C-1118 were constructed for room temperature and 100° C from data collected from a number of fatigue tests. The endurance limit of the steel was estimated at the same temperatures from additional fatigue tests. Cyclic tensile tests were performed on several specimens at each of the two temperatures, with each specimen receiving many cycles of loading and unloading. The proportional limits obtained from the cyclic curves were averaged for each temperature. The value thus obtained for the proportional limit was compared with the endurance limit, and there appears to be good agreement. Author

N64-29772 Los Almos Scientific Lab., N. Mex.
CORROSION OF STAINLESS STEELS BY WATER BOILER REACTOR FUELS
Harold M. Busey and Ralph H. Perkins 25 Aug. 1964 27 p refs
(Contract W-7405-ENG-36)
(LA-3101) OTS: $0.50

Type 316, 316-L, 321, and 347 stainless steels were corrosion tested in both nitric- and phosphoric-acid solutions for 3 years. These tests were made at 95° C under reflux conditions in the presence of air. The 0.05 M uranyl solutions contained 0.10 M HNO_3 or 0.75 M H_3PO_4 to simulate the concentrations that might be used in aqueous homogeneous, water-boiler type, nuclear-research reactors. Each test coupon contained a weld, and metallographic examinations were made of weld, nonweld, and liquid interface regions of the coupons after the 3-year tests. Photographs of the solution–metal interface are shown. The H_3PO_4-type fuel solution was found to be much less corrosive to these stainless steels than was the HNO_3 solution. Types 316 and 316-L were corroded least by the phosphate solution. The change in concentration of corrosion-product iron in the Los Alamos Water Boiler is shown for a 15-year period. Author

N64-29805 Army Materials Research Agency, Watertown, Mass. Materials Research Div.
THE MAGNETIC ENTROPY OF ALPHA MANGANESE
Charles P. Gazzara, Raymond M. Middleton, and R. J. Weiss Mar. 1964 9 p refs
(AMRA-TR-64-07; AD-603213)

A separation of the magnetic contribution from the total specific heat has been made, using an experimentally determined (X-ray diffraction) value of the Debye characteristic temperature to obtain the lattice specific heat of alpha manganese. The magnetic entropy was found to be approximately 25% of the accepted value. Author

N64-29806 Battelle Memorial Inst., Columbus, Ohio
THE EFFECTS OF INTERSTITIALS ON THE INTERNAL FRICTION OF CHROMIUM
M. J. Klein and A. H. Clauer Wright-Patterson AFB, Ohio, ARL, May 1964 52 p refs
(Contract AF 33(616)-7993)
(ARL-64-88; AD-603506)

The diffusivity and solubility of nitrogen in chromium were investigated by internal-friction measurements. The anomaly in the Young's modulus and the damping peak associated with it at 40° C were also studied. A rapid quenching rate is required to maintain nitrogen in solution in chromium in sufficient concentrations to be detectable by internal friction techniques. Internal friction effects arising from the stress-induced ordering of nitrogen appear to be present in Cr-1Re and Cr-35Re. The modulus and damping behavior near the Néel temperature of chromium are influenced by the thermal history, the state of stress, and the carbon and nitrogen concentration of chromium. Changes in the modulus and damping for nitrogen- and carbon-loaded chromium rods as a function of heat treatment are attributed to variations in the morphology and distribution of the interstitial dispersions. Author

N64-29842 Bendix Corp., South Bend, Ind. Bendix Products Aerospace Div.
DEVELOPMENT OF IMPROVED STRENGTH AND OXIDATION RESISTANCE IN CHROMIUM COMPOSITES Quarterly Report, 17 Mar.–16 Jun. 1964
W. A. Farrington 10 Jul. 1964 24 p
(Contract NOw-64-0321-c)
(QR-1; AD-603124)

Work on improved atmospheric contamination resistance above 2,200° F, room-temperature ductility, and high-temperature strength of chromium—ceramic composite materials was limited to a study of the effect of raw material impurities on oxidation resistance. The minor impurity content of raw magnesia used for preparation of a chromium-6% MgO composite appeared to effect a twofold increase in the oxidation weight gain resistance of the material. Efforts directed toward further improvement of oxidation resistance and strength are presently underway. Author

N64-29870 Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Labs.
STUDY OF THE FEASIBILITY OF APPLYING ULTRASONIC ENERGY TO THE ROLLING PROCESS FOR SHEET METALS Bimonthly Progress Report, 6 Apr.–6 Jun. 1964
James W. Cunningham and Ronald J. Lanyi [1964] 67 p ref
(Contract NOw-64-0294-j)
(BPR-2; AD-603173)

.Ultrasonic energy was applied to the rolling process by attaching a transducer directly to an aluminum workpiece. This technique reduced rolling load a maximum of 13% and typically

6%. This effect is attributed to decreased friction in the roll gap. No acoustic reduction in yield strength was apparent in these experiments even though sound intensities were capable of cracking reduced thin aluminum bars. Author

N64-29887 Battelle Memorial Inst., Columbus, Ohio
CHEMICAL DIFFUSION IN UC_2 AND UC AND THERMAL DIFFUSION IN UC
Knut H. Osthagen and Arthur A. Bauer 12 Aug. 1964 20 p refs
(Contract W-7405-ENG-92)
(BMI-1686) OTS: $0.50

Chemical diffusivities in UC_2 were determined at 1,900°, 2,000°, and 2,050° C on the basis of layer-growth measurements in couples of UC plus UC_2 versus graphite. The diffusivities can be expressed by $D_{UC_2} = 0.082 \exp(53{,}800/RT)$. Phase boundary limits used in the diffusion analysis were checked in diffusion couples prepared with C^{14}. Estimates of diffusivities in UC were also made, and values of 1.8×10^{-6} and 6.5×10^{-6} cm^2 per sec at 1,900° and 2,050° C, respectively, were obtained. Experiments were performed to study the conditions for thermal diffusion in UC. Within the limits of the experimental techniques, no evidence of thermal diffusion was detected in thermal-gradient specimens with maximum hot-end temperatures of 1,900° C and temperature gradients of 500° C per cm after heating up to 93 hr. Author

N64-29900 Universal-Cyclops Steel Corp., Bridgeville, Pa. Refractomet Div.
DEVELOPMENT OF TUNGSTEN SHEET BY THE USE OF ULTRA FIN TUNGSTEN METAL POWDER Interim Report No. V, 26 Apr.–25 Jul. 1964
J. H. Schwertz Aug. 1964 34 p
(Contract AF 33(657)-10513)
(ASC-TR-8-107 (V); AD-444433)

Evaluation of cold pressing and sintering of 0.08- to 0.2-micron tungsten plus 1% thoria powder, and their effect on density and grain size, have been completed. Initial hot-pressing attempts have been made; design modifications on the hot-press assembly were necessary. High-energy-rate compaction studies (Dynapak) on three samples were made, and severe delaminations were produced. Author

N64-29904 IIT Research Inst., Chicago, Ill.
VANADIUM ALLOY STUDIES Bimonthly Report, Jun. 1–Jul. 31, 1964
D. Weinstein and F. C. Holtz [1964] 13 p ref
(Contract NOw-64-0239-c)
(IITRI-B6021-3; AD-605203)

A vanadium alloy development program is being conducted for the purpose of producing improved short-time creep properties in the temperature range 2,200° to 2,400° F. The composition V-40Cb-30Ta-1Ti presently represents the material having the best creep properties without a sacrifice of fabrication or coating capability; on the basis of creep strain over a 2-hr period at 2,200° F, it is an order of magnitude better than any previous vanadium alloy. Work on modification of this composition using approaches to produce a stable, high-strength particle dispersion is continuing. Author

N64-29937 Syracuse U., N.Y.
THE EFFECT OF TESTING SYSTEM STIFFNESS ON FRACTURE Technical Documentary Report, Apr. 1, 1963–Mar. 31, 1964
V. Weiss, K. S. Grewal, and Sessler Wright-Patterson AFB, Ohio, AF Mater. Lab., Apr. 1964 35 p refs
(Contract AF 33(657)-11154)
(ML-TDR-64-150; AD-602158)

A preliminary study of the influence of testing system stiffness on the fracture of center-cracked sheet specimens of 7075-T6 aluminum indicated that decreasing the testing system stiffness resulted in the suppression of the slow or intermittent crack growth. A controlled experimental program on titanium RS 140 to study the interplay between specimen length and crack length, the two variables affecting the stiffness on both crack propagation and fracture strength. Compliance curves, obtained with a specially designed compliance gage, showed a higher strain energy release rate for a given incremental crack growth in short specimens. The lower fracture strength observed in short specimens may be explained on this basis. Both energy and stress considerations of the effects of testing system stiffness are presented. Author

N64-29953 Oak Ridge National Lab., Tenn.
DEFORMATION TWINNING IN THE COLUMBIUM-VANADIUM ALLOY SYSTEM
D. O. Hobson (M.S. Thesis—Tennessee U.) Sep. 1964 88 p refs
(Contract W-7405-ENG-26)
(ORNL-3678)

The twinning transition temperature was found to vary with alloy composition, with a maximum occurring at approximately 140° C in the 40% vanadium alloy. The temperature ranges over which the transitions occurred were extremely narrow, often less than 5° C. Alloy compositions from 20% to 70% vanadium were cold workable by rolling. The 10%, 80%, and 90% vanadium alloys cracked and were not twinnable. The addition of up to 7,000 ppm oxygen lowered the twinning transition temperature in all alloys tested. The curve geometry was directly related to the curve of transition temperature versus alloy composition for the uncontaminated alloys. The twinning transition temperature for a 30% vanadium alloy was found to increase with increasing annealing temperature. Author

N64-29956 Naval Research Lab., Washington, D.C. High Temperature Alloys Branch
EFFECT OF OXYGEN ON CREEP-RUPTURE OF NIOBIUM
J. Stoop and P. Shahinian 10 Jul. 1964 18 p refs
(Contract AT(49-5)-1907)
(NRL-6095; AD-604337)

The creep-rupture properties of electron-beam-melted niobium with additions of oxygen up to 0.35 wt.% were determined at 1,900°, 2,300°, and 2,600° F at vacuums of 1×10^{-5} torr or better. Rupture life generally increased and minimum creep rate decreased as the level of oxygen was raised. There was no deleterious effect on ductility even with the high oxygen additions. Increases in hardness as a function of cold work and oxygen content were obtained. Activation energies for high-temperature creep were determined, which showed good agreement with the reported experimental activation energies for self-diffusion. At 1,900° F, but not at 2,300° and 2,600° F, an anomalous behavior occurred that was manifested by a rapid acceleration followed by a deceleration in the flow process. The irregularity, which is represented as a step in the creep curve, occurs only under certain combinations of temperature, stress, and oxygen content. Author

N64-29957 Naval Research Lab., Washington, D.C. High Temperature Alloys Branch
EFFECT OF ELECTRON BOMBARDMENT HEATING ON SURFACES OF TUNGSTEN

H. Doering and P. Shahinian 22 Jul. 1964 18 p refs
(NRL-6119; AD-604170) OTS: $0.50

Heating to very high temperatures by electron bombardment often roughens (or damages) metal surfaces. This damage to grain boundaries and grain surfaces is examined in electropolished sheet and foil specimens of tungsten. The effects of heating by stationary and oscillating 10-kv beams are compared with the effects produced by thermal radiation. At moderated temperatures, stationary beams induce grain-boundary grooving as does thermal radiation, whereas oscillating beams produce ripples in the surface. At high temperatures, stationary beams and thermal radiation produce pits, whereas oscillating beams produce cracks, and tilted and dislodged grains. The more severe effects produced by oscillating beams are shown to be associated with thermal cycling. Author

N64-29959* Naval Research Lab., Washington, D.C. Chemistry Div.
HIGH TEMPERATURE PROPERTIES OF SODIUM, POTASSIUM, AND CESIUM Progress Report No. 14, 1 Jan.–31 Mar. 1964
J. P. Stone, C. T. Ewing, J. R. Spann, E. W. Steinkuller, D. D. Williams et al 3 Aug. 1964 54 p refs
(Contract NAS-C-76320)
(NRL-6128; AD-605277) OTS: $1.25

Experimental values are presented for the pressure–volume–temperature properties of sodium vapor and the density of sodium liquid. Two equations of state are advanced for sodium, and properties of the saturated and superheated vapor are derived from these equations by a thermodynamic treatment, which is presented in outline form. Enthalpy, entropy, specific volume, and specific heat and compositional information (weight fraction of dimer, weight fraction of tetramer, and average molecular weight) are tabulated for some 800 selected vapor states in the temperature range from 1,625° to 2,575° F, and in the pressure range from 0.2 to 26 atm. Similar tables for potassium, which were previously reported, were computed from a saturated liquid base. These tables have been recomputed using properties of the monomeric gas as a base, and are published in this report. Author

N64-29962 Naval Research Lab., Washington, D.C. X-Ray Optics Branch
ELECTRON PROBE MICROANALYSIS OF THE DIFFUSION SYSTEMS β-TITANIUM-VANADIUM, β-TITANIUM-NIOBIUM, AND CHROMIUM-VANADIUM
R. E. Seebold 14 Aug. 1964 18 p refs
(NRL-6141; AD-605317) OTS: $0.50

The diffusions of niobium and vanadium into pure β-titanium at 1,100° C have been studied. Concentration versus distance curves for these systems are similar to each other but are skewed and different in shape from the gaussians expected in self-diffusion. At temperatures between 1,050° and 1,200° C the curves for chromium–vanadium diffusion do approximate gaussians. Diffusion coefficients for all three systems have been calculated by Matano's method at elemental concentrations from 5 at.% to 95 at.%. Logarithms of the diffusion coefficients D for β-titanium with both niobium and vanadium follow a reasonable straight-line relationship with the at.% of the solute element. Author

N64-29972 Lockheed Missiles and Space Co., Palo Alto, Calif. Metallurgy and Ceramics Lab.
BERYLLIUM RESEARCH AND DEVELOPMENT PROGRAM. METALLURGICAL FACTORS AFFECTING THE DUCTILE-BRITTLE TRANSITION IN BERYLLIUM Technical Documentary Report, 1 Oct. 1961–31 Mar. 1963
M. I. Jacobson Wright-Patterson AFB, Ohio. AF Mater. Lab., Jul. 1964 83 p refs
(Contract AF 33(616)-7065)
(ASD-TDR-62-509, Vol. V; AD-604599)

An investigation was made of the factors controlling the ductile–brittle behavior of two grades of commercial purity beryllium, Brush QMV, and Pechiney CR. Tensile tests were made on randomly oriented samples at temperatures from 23° to 500° C. Extrusions were tested in the longitudinal and transverse directions in the range −195° to 200° C. Three grain sizes of each material were investigated, and comparisons were made between specimens tested in the aged and unaged conditions. The aging treatment was 900° C for 6 hr followed by 48 hr at 700° C. Mechanical properties of both materials were very similar after this heat treatment, and no advantage could be claimed for the higher purity Pechiney beryllium. Aging reduced the amount of impurities in solid solution and contributed to improved ductility in certain temperature ranges. In general, the transition temperature was lower the smaller the grain size, the slower the strain rate, and the purer the material. Author

N64-29976 Pfaudler Co., Rochester, N.Y.
ADVANCED DEVELOPMENT OF PFR-6
P. J. Chao, G. J. Dormer, and B. S. Payne, Jr. Wright-Patterson AFB, Ohio, AF Mater. Lab., May 1964 120 p
(Contract AF 33(616)-8125)
(ML-TDR-64-84; AD-603203)

The PFR-6 alloy coating, initially developed in the laboratory to protect molybdenum alloys against high-temperature oxidation, has been scaled up and optimized for use at an intermediate level. Pure molybdenum, Mo-0.5 Ti, and TZM have been successfully coated with this pack cementation process. Substrate preparation, pack composition, heat transfer in the retort, and the process cycle were studied extensively to establish desired conditions for applying PFR-6 to components up to 1.5-ft long. Assemblies must be coated before and after riveting to obtain adequate protection. Two nondestructive measurements were found that will indicate within statistical limits expected coating life. Author

N64-29980 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
THE MEASUREMENT OF PHOTOELASTICITY
A. Barat 10 Aug. 1964 21 p Transl. into ENGLISH from Machines et Metaux (France), v. 31, 1947
(RSIC-244; AD-604603)

A method for solving two-dimensional problems associated with naval construction, through the use of photoelastic measurements, is described. This method utilizes the phenomena of temporary birefringence produced in transparent isotropic substances by external loads. In essence, the photoelastic procedure consists of using a model, of a suitable transparent substance, representing the structural element studied on a reduced scale. Forces determined by the rules of mechanical analogy are applied to this model, whose optical study makes it possible to deduct the distribution of the stresses and their magnitude and direction in the real element. I.v.L.

N64-29985 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
DIFFUSION OF SILICON IN TITANIUM, TANTALUM, MOLYBDENUM, AND IRON
G. V. Samsonov, M. S. Koval'chenko et al 19 Jun. 1963 8 p refs Transl. into ENGLISH from Dopovidi Akad. Nauk Ukr. RSR (Kiev), no. 1, 1959 p 32–36
(FTD-TT-63-262/1+2; AD-602404)

Investigations were made on samples of titanium, tantalum, molybdenum, and iron. These were all saturated with silicon in an argon atmosphere from a solid phase bath consisting of 97% Si and 3% NH_4Cl. Ammonium chloride was introduced into the batch, accelerating the diffusion. These investigations were carried on for a period of 4 years, with saturation time varying at temperatures of 600°, 900°, 1,000°, and 1,200° C, respectively, for titanium and iron, molybdenum, and tantalum. During silicon diffusion, monophase silicide layers are formed at low temperatures, and two-phase layers are formed at the high temperatures. An increase in the silicon content in the layer, as a rule, leads to a sharp rise in piercing stress. A.W.

N64-29990 Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J.

THICKNESS AND COMPOSITION OF VACUUM-DEPOSITED NICKEL-CHROMIUM FILMS

Isaac H. Pratt, William L. Wade, and William Weintraub Mar. 1964 35 p refs

(USAELRDL-TR-2419; AD-605294)

Thin films of nickel–chromium were deposited on planar glass substrates by vacuum evaporation of the alloy Nichrome V with a nominal bulk composition, Ni 80%–Cr 20%. The nickel–chromium ratio of deposited films was determined by chemical microanalysis (using spectrophotometric methods), and the thickness by optical interferometry. The interdependencies of thickness t, composition ratio r, sheet resistivity ρs, temperature coefficient of resistance α, film density δ, and other film parameters were investigated or derived, and the interrelations of these variables are discussed. It is shown quantitatively how, under constant evaporation and deposition conditions, the nickel–chromium composition ratio varies with the sheet resistivity r (ρs) and how, on the other hand, the sheet resistivity varies with the thickness of these films, $\rho s(t)$. Author

N64-29999 Pennsylvania State U., University Park Solid State Microstructures Research Lab.

DIRECT OBSERVATIONS OF FATIGUE INDUCED DEFORMATION FAULTING IN THIN FOIL STAINLESS STEEL Final Scientific Report, Jan. 1–Dec. 31, 1963

L. E. Murr and P. J. Smith May 1964 59 p refs

(Grant AF-AFOSR-165-63)

(AFOSR-64-1004; AD-602797)

A study has been made by transmission electron microscopy of thin foils of 304 stainless steel fatigued external to the electron microscope in reversed bending, and of thin foils fatigued directly within the microscope in alternating tension. The buildup of slip deformation striations and stacking faults in the thin foils during fatigue was correlated with the dislocation structures found in thin films prepared from fatigued bulk specimens. The performance of the special devices designed for fatigue of thin foils so outlined, and the importance of alternative methods of preparation of more uniform fatigue specimens by vapor deposition are emphasized. Author

N64-30058 Syracuse U. Research Inst., N.Y.

AEROSPACE STRUCTURAL METALS HANDBOOK. VOLUME II. NON-FERROUS ALLOYS

V. Weiss, ed. Wright-Patterson AFB, Ohio, AF Mater. Lab., Dec. 1963 167 p refs

(Contract AF 33(616)-7792)

(ASD-TDR-63-741, Vol. II, Suppl. I; AD-443104)

New and revised material on nonferrous alloys is issued for insertion in the existing handbook. An appendix discusses fracture toughness. R.L.K.

N64-30066 Bureau of Mines, Rolla, Mo. Metallurgy Research Center

EFFECT OF URANIUM ON THE ISOTHERMAL TRANSFORMATION AND HARDENABILITY OF A LOW-ALLOY STEEL

K. A. Fowler and L. W. Higley, Jr. 1964 21 p refs

(BM-RI-6515)

The effect of uranium on the transformation kinetics and the hardenability of a low-alloy steel was evaluated. Isothermal transformation curves were developed from metallographic studies, and hardenability was determined by standard Jominy end-quench tests. For the steels investigated, the addition of 0.15 wt.% uranium was found to produce a significant shift in the isothermal transformation curve and caused a related increase in hardenability. These effects diminished rapidly when the uranium content was increased above 0.2 wt.%. Author

N64-30111 General Electric Co., Evandale, Ohio Advanced Engine and Technology Dept.

PROCEDURE FOR EVALUATION OF COATED REFRACTORY ALLOYS Technical Report, Apr. 1961–May 30, 1962

M. A. Levinstein and J. D. Marble Wright-Patterson AFB, Ohio, AF Mater. Lab., Jun. 1964 205 p refs

(Contract AF 33(616)-8154)

(ML-TDR-64-70; AD-604738)

A simple corrugated specimen was designed to determine the applicability of current coatings to a fabricated structure. Coated specimens were oxidation tested at 2,500° F up to 10 hr, and sectioned for metallographic examination and hardness determination. Dynamic oxidation tests were conducted using a gas-fired flame tunnel and a plasma test stand. Effects of the coatings and elevated temperature exposure on basis metal properties were established by combined stress, fatigue, and tensile tests. Coatings from six sources were investigated. Author

N64-30155 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

INFLUENCE OF STRAIN RATE ON RESISTANCE TO DEFORMATION OF METALS AT IMPACT VELOCITIES OF 10^2 TO 10^3 M/SEC

F. F. Vitman and V. A. Stepanov 24 Aug. 1964 24 p refs Transl. into ENGLISH from the book "Nekotoryye Problemy Prochnosti Tverdogo Tela", Moscow, Akad. Nauk SSSR, 1959 p 207–221

(FTD-MT-64-217; AD-605234)

The role of velocity, as related to the problem of the resistance level of metals to plastic flow, was investigated at impact velocities of 10^2 to 10^3 m/sec. The following metals afforded the test specimens: lead, aluminum, commercially pure copper, and duralumin. Results show that, in addition to the forces of natural resistance to deformation, inertial resisting forces are incurred. I.v.L.

19 MATERIALS, NONMETALLIC

Includes mechanical and physical properties of nonmetals (e.g., plastics). *For related information see*: 07 Chemistry; 17 Machine Elements and Processes; 18 Materials, Metallic; 33 Stresses and Loads; and 34 Structural Design.

N64-29281 General Dynamics/Fort Worth, Tex. USAF Nuclear Aerospace Research Facility
RADIATION RESISTANCE OF SIX SPECIALLY FORMULATED O-RING COMPOUNDS
P. M. Johnson and T. R. Morgan 28 Feb. 1964 158 p refs
(Contract AF 33(657)-7201)
(NARF-63-15T; FZK-9-189; AD-443035)

The radiation and temperature resistance of six O-ring compounds, specially formulated for radiation resistance, was determined by irradiation in air and in oil in the NARF Ground Test Reactor. Doses ranged from 5.5×10^8 ergs/gm(C) to 9.8×10^9 ergs/gm(C). All were irradiated at 75° F and at an elevated temperature of approximately 275° or 375° F, depending upon the recommended temperature range for each material. Test results are reported for tensile properties, specific gravity, hardness, compression set, volumetric swell in fluid, and leakage when tested in a seal bench tester. Author

N64-29303 Army Missile Command, Huntsville, Ala. Physical Sciences Lab.
BIAXIAL STRESS-STRAIN BEHAVIOR OF NYLON TUBE SPECIMENS
R. E. Ely 20 Jul. 1964 45 p refs
(RR-TR-64-11; AD-444775)

Biaxial stress and strain data are given for nylon 101 tube specimens. Data are given for room temperature tests for 10 stress states. These states were obtained by subjecting the tube specimens to internal fluid pressure and axial loads, both tension and compression. The effect of strain rate on properties is evaluated for uniaxial loading. The biaxial data are compared with theoretical failure criteria, and it is concluded that the mechanical behavior of nylon for small strains conforms to theories used with ductile metals. Author

N64-29371* General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science
INVESTIGATIONS OF CARBIDES AS CATHODES FOR THERMIONIC SPACE REACTORS Final Report
L. Yang, D. L. Bosseau, F. D. Carpenter, N. Elsner, W. W. Godsin et al 17 Mar. 1964 493 p refs
(Contract NAS3-2532)
(NASA-CR-56280; GA-4769, Pt. 1) OTS: $23.50 ph

Among the results summarized are the following: (1) No significant effect on the rates of vaporization of 30UC-70ZrC and 90UC-10ZrC was produced by the presence of Cs vapor at a pressure of 1.8 torr. (2) Four cells containing different emitters, 90UC-10ZrC, 30UC-70ZrC, W-clad UC, and W-clad 30UC-70ZrC, were fabricated and tested for periods up to a few hundred hours. (3) Studies made on 30UC-70ZrC and 90UC-10ZrC emitters have shown that open porosity increases the vaporization loss, but does not affect the electron emission significantly. (4) The vacuum-vaporization rates of UC and 90UC-10ZrC decrease in the presence of a high-temperature collector, but the vacuum-vaporization rate of 30UC-70ZrC is not affected. The rate of vaporization of UC is not affected by the presence of CsF at a pressure of 3×10^{-5} torr. (5) The vacuum-vaporization rates and electron emission of $UMoC_2$, 30UC-70NbC, and 30UC-70TaC were studied. (6) Methods were developed for preparing submicron-size UC-ZrC powder, UC-ZrC carbide bodies of graded composition and U^{235} concentration, UC-ZrC bodies of controlled composition, structures, and pore structures, and W-UC and W-UO_2 cermets. I.v.L.

N64-29426 Union Carbide Corp., Lawrenceburg, Tenn. Advanced Materials Lab.
RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS. VOLUME XIII: DEVELOPMENT OF A FINE-GRAIN ISOTROPIC GRAPHITE FOR STRUCTURAL AND SUBSTRATE APPLICATIONS Technical Documentary Report, May 1960–Sep. 1962
R. A. Howard and E. L. Piper Wright-Patterson AFB, Ohio, AF Materials Lab., May 1964 36 p refs
(Contract AF 33(616)-6915)
(WADD-TR-61-72, Vol. XIII; AD-601753)

This report describes the development, fabrication, and physical properties of grade RVC graphite. Grade RVC has been manufactured in sizes up to 18 in. in diameter by 15 in. in length and is nominally characterized by a bulk density of 1.81 g/cc, an admittance to N_2 of 2×10^{-2} and 6×10^{-3} cm^2/sec with-the-grain and across-the-grain, respectively, and a room-temperature flexural strength w.g. and a.g. of 2,560 and 1,930 $lb/in.^2$, respectively. RVC is an excellent substrate material for silicon carbide coatings because its thermal expansion between 400° and 1,000° C is approximately 0.3% in both grain directions. This expansion is in the same range as that for silicon carbide. Results are also presented on high-temperature oxidation of silicon-carbide-coated grade RVC specimens. Author

N64-29507* IIT Research Inst., Chicago, Ill.
DEVELOPMENT OF SPACE-STABLE THERMAL-CONTROL COATINGS (PAINTS WITH LOW SOLAR ABSORPTANCE/EMITTANCE RATIOS) Triannual Report, Jan. 20–Jun. 20, 1964
Gene A. Zerlaut, Y. Harada, and L. U. Berman 20 Jul. 1964 58 p refs
(Contract NAS8-5379)
(NASA-CR-58706; IITRI-C6014-13) OTS: $5.60 ph

The principle problems associated with the use of foamed (microporous) polymer films are discussed in detail. Recent studies with a proprietary silicone blowing agent and with techniques involving the preparation of silicone resin emulsions have shown promise as methods of preparing microporous, foamed surface coatings. The most important aspects of the inorganic studies involved the improved reflectance and ultraviolet-vacuum stability realized by heat treating the pigments and the coatings made from them. The effect of grinding time (mill time) on the reflectance and stability of zinc oxide-silicone paints are discussed. It was found that long mill times cause increased solar absorptance and decreased stability of these paints. The effect of pigment particle size was investigated, and experiments are discussed that involve mixing two zinc oxide pigments with widely different mean particle sizes. Author

N64-29608 Mound Lab., Miamisburg, Ohio
EVALUATION OF THERMOSETTING PLASTIC MOLDING POWDERS WITH A CAPILLARY EXTRUSION RHEOMETER
J. W. Heyd, R. M. Brodbeck, L. E. Brown, and L. W. Hartzel 10 Aug. 1964 15 p refs
(Contract AT(33-1)-GEN-53)
(MLM-1211) OTS: $0.50

A capillary extrusion rheometer was used with an Instron testing machine to measure the flow properties of an asbestos-filled diallyl phthalate molding powder. Variations in extrusion characteristics caused by different reaction temperatures, die orifices, crosshead speeds, catalyst concentrations, and inhibitor concentrations were readily detected by the instrument. The flow properties of 20 commercial thermosetting molding

powders were measured. The rheometer discriminates readily between hard and soft modifications of plastic materials with a precision of about 1%. Author

N64-29656 Quantum, Inc., Wallingford, Conn.
STUDIES OF LOW FRICTION COATINGS FOR VULCANIZED ELASTOMERS Progress Report, 8 Apr.–8 Jul. 1964
Richard F. Horan [1964] 22 p
(Contract NObs-90313)
(PR-1; AD-443073)

Studies have been initiated in low-cost processes that produce low-friction surfaces on natural and synthetic vulcanized elastomers. Butyl rubber was chosen as the first saturated elastomer to be treated by photolytic graft polymerization of chlorinated monomers to the surface of the rubber. Ten specific treatments have demonstrated a fivefold increase in wear life on a high-speed rotary wear tester as a result of having low friction surfaces. Of the two chlorinated monomers tested as surface grafting agents, trichlorethylene appears to have less effect than perchlorethylene on the tensile properties of treated elastomers. Author

N64-29792 Naval Ordnance Lab., White Oak, Md.
THERMODYNAMIC PROPERTIES OF NATURAL RUBBER AND ISOPRENE
R. W. Warfield and M. C. Petree 18 Jun. 1964 17 p refs
(NOLTR-64-79; AD-604549)

Using published specific heat data, the entropy, enthalpy, and Gibbs free energy of natural rubber (NR) have been calculated over the temperature range 0° to 320° K. These functions have also been calculated for isoprene over the temperature range 0° to 300° K. At 298.16° K the entropy of polymerization was found to be 24.00 cal/mole deg, and the free energy of polymerization −10.7 kcal/mole. The thermodynamic function Cp/T versus T calculated for NR exhibits a maximum at 50° K and another maximum at 210° K, which is associated with the glass transition. The number of classically vibrating units per repeating unit of NR is 6.61 at 300° K. Author

N64-29804 General Dynamics/Fort Worth, Tex. Engineering Dept.
EFFECTS OF NUCLEAR RADIATION ON THE MECHANICAL, OPTICAL AND ELECTRICAL PROPERTIES OF MERLON POLYCARBONATE
E. G. Fritz 3 Mar. 1964 56 p refs
(Contract AF 33(657)-7201)
(NARF-63-19T, FZK-9-195; AD-603445)

Merlon polycarbonate was exposed in a nuclear reactor at room temperature in air to five levels of absorbed dose: 3.07×10^8, 6.8×10^8, 1.53×10^9, 3.83×10^9, and 1.18×10^{10} ergs/gm(C). The material showed an excellent postirradiation retention of various mechanical properties. No significant changes in ultimate tensile strength and Shore-D hardness were observed up to an absorbed dose of 1.53×10^9 ergs/gm(C). The yield stress, however, was found to decrease steadily with dose. The G-value for radiation-induced scission was calculated on the basis of the heat of necking to be 0.18 scissions/100 ev. The apparent optical density of the samples at the OH-absorption peak at 2760 mμ was determined to be a linear function of the logarithm of absorbed dose. Author

N64-29811 General Dynamics/Fort Worth, Tex. Nuclear Aerospace Research Facility
EFFECTS OF NUCLEAR RADIATION ON POLY(N-VINYL CARBAZOLE)
E. G. Fritz 31 Mar. 1964 29 p refs
(Contract AF 33(657)-7201)
(NARF-63-14T; MR-N-307; AD-603443)

The stress–strain behavior, Shore-D hardness, and oxygen sorption of poly(N-vinyl carbazole) were studied as a function of dose absorbed in the mixed radiation field of a nuclear reactor. The samples were irradiated in air at room temperature to three different doses: 5.9×10^9, 1.1×10^{10}, and 6.4×10^{10} ergs/gm(C). Within this dose range, the elastic modulus increased slightly with dose, but the general shape of the stress–strain curve was not changed by radiation. At a significance level of 0.01, the tensile strength appeared unaffected, whereas at a significance level of 0.025, the results of the analysis suggested an initial increase at 1.1×10^{10} ergs/gm(C), followed by a small decrease at the highest dose. No significant change in Shore-D hardness was observed. The postirradiation sorption of oxygen in irradiated PNVC increased with absorbed dose up to a saturation value. On the basis of oxygen sorption, the G(scission)-value was roughly estimated to be 0.128 scissions/100 ev. Author

N64-29865 Naval Ordnance Lab., White Oak, Md. Physical Chemistry Div.
BEHAVIOR OF PLEXIGLAS UNDER SHOCK LOADING BY A TETRYL DONOR
I. Jaffe, J. Toscano, and D. Price Sep. 1964 65 p refs
(NOLTR-64-66; AD-603656)

Experiments to establish pressure as a function of distance in a 5.08- × 5.08- × 12.7-cm rectangular parallelopiped of Plexiglas, shocked by a tetryl donor, result in a shock velocity (or pressure) vs. distance curve, within experimental precision, the same as that for a Plexiglas rod of 5.08-cm diameter. Shock front curvature and the average unloading rate between shock and breakup each shows a discontinuity when plotted as a function of length of shock path through the material. The point of discontinuity is at 2.54 cm (the radius of the shock loaded surface), and is attributed to the arrival and intersection of the lateral rarefactions at the axis of the block. A one-dimensional computation indicates that the shock entering the tetryl loaded Plexiglas will fall from its initial stress to half that value in 4 μsec. However, the experimental results indicate a fall from the initial value to about −1 kbar in less than 2 μsec. Author

N64-29922 Kaysam Corp. of America, Patterson, N.J.
NEOPRENE ELASTOMERS FOR BALLOON FABRICATION First Quarterly Progress Report, 1 Mar.–31 May 1964
Eric Nelson [1964] 47 p
(Contract DA-36-039-AMC-03737(E))
(Rept.-1; AD-444967)

Films were obtained from solvent solutions of dry neoprene polymers. Agerite superlite was compared with Wingstay 'T'. A group of recommended plasticizers was evaluated and compared with butyl oleate and dibutyl sebacate. The use of filter media for latex compounds was investigated, and the microscopic examination of balloon films and balloon compounding ingredients was continued. Flights were conducted with 1,200-gram balloons from a standard compound and an all-zone compound. Both types of balloon reached 110,000 ft in altitude. Also, a series of flights was made with 1,000-gram, 1,500-gram and 2,000-gram balloons manufactured from a high elongation compound. Author

N64-29961 Naval Research Lab., Washington, D.C. Surface Chemistry Branch
SOME SURFACE CHEMICAL ASPECTS OF GLASS-RESIN COMPOSITES. PART I: WETTING BEHAVIOR OF EPOXY RESINS ON GLASS FILAMENTS

Willard D. Bascom 10 Aug. 1964 23 p refs
(Contract Nonr(PO)4-0075)
(NRL-6140; AD-604682) OTS: $0.50

A study was made of the wetting behavior of epoxy resins on glass filaments and its relation to the fabrication and the properties of filament wound glass-resin composites. The experiments were designed to determine how wetting is affected by the surface finish on the glass, the molecular structure of the epoxy liquid, and the presence in the liquid of a curing agent. The wetting studies also provided other pertinent information: (1) The dynamic advancing contact angle formed against a fiber as it moves into the liquid was generally about 10° to 20° higher than the static, equilibrium advancing angle. (2) The HTS- and silane-finished glass fibers were covered with a visible coating of the sizing material. (3) The coating materials were only partially soluble in the epoxy liquids. Author

N64-30061 IIT Research Inst., Chicago, Ill. Technology Center
AN INVESTIGATION OF MATERIAL PARAMETERS INFLUENCING CREEP AND FATIGUE LIFE IN FILAMENT WOUND LAMINATES Final Report, Oct. 1, 1962–Mar. 31, 1964
R. H. Cornish, B. W. Abbott, and C. K. Cole May 1964 48 p
(Contract NObs-86461)
(AD-602495)

The results of a program to study the environmental (wet vs dry) effects on the biaxial fatigue and creep (stress-rupture) performance of glass reinforced plastics having 20% and 26% resin contents are presented. Characterization of the materials studied in regard to resin content and density determination, ultrasonic flaw detection, and residual stress is included. Correlation of ultrasonic flaw scan patterns with sites of principal failure is made. Residual strain measurements on ring specimens using both "peel" and "cut coupon" techniques are shown to indicate residual tensile stress on the inside surface of the ring and residual compression on the outside. Techniques used for fatigue specimen preparation and evaluation are delineated. The results of wet and dry biaxial fatigue experiments at nominal cycle rates of 200 cph are presented and compared. The results indicate no significant difference in performance of either of the materials considered for the wet and dry test environments used. Author

N64-30171 Massachusetts U., Amherst Polymer Research Inst.
RELATIONSHIP BETWEEN MORPHOLOGY AND DEFORMATION MECHANISMS OF POLYOLEFINS II
K. Sasaguri, R. Yamada, and R. S. Stein 21 Apr. 1964 39 p refs
(Contract Nonr-3357(01))
(ONR-TR-70; AD-603065)

A two-stage mechanism for the deformation of crystalline polyolefin polymers was proposed previously according to which the spherulitic superstructure first deforms, followed by a time-dependent crystalline rearrangement characterized by a compliance γ that depends upon crystallinity, temperature, and morphology. In this paper, the implications of this deformation theory are examined in detail. More critical studies are reported using uniaxially crystallized samples. The variation of properties in a series of ethylene–propylene copolymers is studied and explained in terms of the proposed mechanisms. M.P.G.

N64-30174 Massachusetts U., Amherst Polymer Research Inst.
DYNAMIC DICHROISM OF POLYMER FILMS
Kigen Kawai and Richard Stein 30 Apr. 1964 27 p refs
(Contract Nonr-3357-(01))
(ONR-TR-68; AD-603063)

The use of anisotropic dye molecules to tag the amorphous or disordered regions of polycrystalline polymers is discussed. This method is based on the fact that the visible absorption spectra of anisotropic dyes will be dichroic, and that such absorbance is dependent upon the orientation of the dye with respect to the polymer. The use of polymer samples in the form of films provides an easier geometry for optical techniques and permits ready application of dynamic techniques that may be correlated with simultaneous studies of mechanical properties, birefringence, X-ray diffraction, and infrared dichroism. A theoretical analysis of the technique is presented. M.P.G.

N64-30194 Kaysam Corp. of America, Patterson, N.J.
STUDY OF PHYSICAL AND CHEMICAL CHARACTERISTICS OF BALLOONS AND BALLOON MATERIALS Final Report, 1 Mar. 1963–29 Feb. 1964
Eric Nelson and Herman Newstein [1964] 152 p
(Contract DA-36-039-AMC-02160(E))
(AD-601997)

The objective of this study was to improve the performance of meteorological balloons by the use of newly developed neoprene polymers (specifically designed for such a purpose) by the use of other basic polymeric materials, by improved compounding and processing, and by a better understanding of atmospheric conditions during flight. The study was divided into two tasks: Task A and Task B. Task A deals with the properties of balloons and balloon films and covers (1) a literature survey; (2) evaluation of raw materials—neoprene polymers, polymers other than neoprene (neoprene latex, polyisoprene latex, natural latex, etc.), and other materials (stabilizers, antioxidants, plasticizers, etc.); (3) evaluation of processing techniques—the use of fine filtration media for balloon compounds; (4) the molecular structure of balloon films; and (5) the development of optimum compounds. Task B deals with the effect of flight conditions on balloon performance and covers (1) the effect of pre-elongation on natural latex films, (2) the effect of ozone on balloon performance, and (3) the effect of infrared radiation on various balloon compounds. I.v.L

20 MATHEMATICS

Includes calculation methods and theory; computers; data processing; and numerical analysis. *For related information see*: 08 Communications; 09 Electronics; 10 Facilities, Research and Support; and 22 Navigation and Guidance.

N64-29020 Stanford U., Calif. Computer Science Div.
THE SOLUTION OF LARGE SYSTEMS OF ALGEBRAIC EQUATIONS
John M. Pavkovich 6 Dec. 1963 52 p
(Contract Nonr-225(37))
(TR-33; AD-427753)

The first step in the solution is to normalize the system, i.e., to multiply each equation by a factor that makes the magnitude of the largest coefficient in the equation approximately equal to 1. The reason for this normalization is to increase the effectiveness of pivoting (interchanging equations during the

solution process) and thus minimize the difficulties associated with round-off errors. The method used to solve the system of equations is basically Gauss's method with partial pivoting. It was implemented on the IBM 7090, but is applicable to any computer that has the ability to read and write tape and to compute simultaneously. I.v.L.

N64-29031 Wisconsin U., Madison Mathematics Research Center
APPROXIMATION AND ALLOCATION
Arthur Wouk Feb. 1963 17 p refs
(Contract DA-11-022-ORD-2059)
(MRC-TSR-382; AD-401217)

The segmented approximation problem is that of finding, for a given function x, a set of n functions y_i in some collection such that the supports of the y_i are pairwise disjoint while some functional of $x-y_1-\ldots-y_n$ is minimized. The recursive functional equation for the "error" of the best approximation by n functions is obtained, and continuity of the error as a function of the set on which approximation occurs is derived from weak conditions on the functional. The allocation of the reduction in error attributable to each of the y_i is studied, and the hereditary nature of an equal allocation principle is established. Author

N64-29176* Massachusetts Inst. of Tech., Cambridge
A MULTI-USER COMPUTATION FACILITY FOR EDUCATION AND RESEARCH
Jack B. Dennis [1963] 30 p refs Submitted for Publication
(Grants NsG-496; NSF G-16526; NIH G-MH-04737-03; Contract Nonr-4102(01))
(NASA-CR-55133) OTS: $2.60 ph

This paper describes the implementation of a small-scale multiuser computer system that permits several users to work independently with the machine, and to obtain quite satisfactory response using typewriter communication. The system also provides for the connection of special equipment to be operated by the program of a particular user. Author

N64-29179* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ABSCISSAS AND COEFFICIENTS FOR THE GENERALIZED GAUSS-LAGUERRE QUADRATURE FORMULA USING THE ZERO ORDINATE
C. R. Cassity and H. R. Hopper (GE Co.) 30 Jul. 1964 69 p refs
(NASA-TM-X-53099) OTS: $6.60 ph

A table is presented that gives abscissas and coefficients for the generalized Gauss–Laguerre quadrature formula using the ordinate at x = 0. The parameter s of the formula

$$\int_0^\infty x^s e^{-x} f(x)\,dx = H_1 f(0) + \sum_{j=2}^{n} H_j f(a_j)$$

covers the range S = −0.99(0.01) −0.90, −0.80, −0.75, −0.7(0.1) −0.3, −0.25, −0.2, −0.1, 0(1) 10. For each s, n = 2(1) 16. Author

N64-29181* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
OPERATION AND MAINTENANCE MANUAL FOR UNIVERSAL PFM REAL-TIME DATA-REDUCTION SYSTEM
May 1964 122 p
(NASA-TM-X-55066; X-651-64-130, Vol. 1) OTS: $10.10 ph

This manual provides the information necessary to set up and operate the equipment, to adapt it to the unique data train of a specific PFM telemetry signal, and to perform preventive and corrective maintenance. The equipment is designed to process the digital and analog data contained in all known PFM telemetry signal formats, and has complete flexibility in programing. The system is capable of processing any signals having a bit rate between 3 and 200 cps, and any ratio of channels per frame or of frames per sequence between the limits of 1 and 16. A choice of frame sync recognition methods is provided. The digital data-processing section can be programed to accommodate up to 21-bit words. D.S.G.

N64-29184* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
OPERATION AND MAINTENANCE MANUAL FOR UNIVERSE PFM REAL-TIME DATA-REDUCTION SYSTEM
May 1964 65 p For Abstract See N64-29181 21-20) OTS: $6.60 ph
(NASA-TM-X-55067; X-651-64-131, Vol. 2)

N64-29189* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PCM DATA PROCESSOR OF THE SATELLITE TELEMETRY AUTOMATIC REDUCTION SYSTEM (STARS) Instruction Manual
H. H. Levy, J. Y. Sos, B. Peavey, P. Heffner, W. P. Barnes et al
May 1964 190 p
(NASA-TM-X-55069; X-544-64-93) OTS: $13.00 ph

This manual describes the function, installation and operation, and the theory of operation of the STARS (Satellite Telemetry Automatic Reduction System) PCM data processor. This processor is the part of STARS PCM data-processing line that includes the time decoder, buffer, and analog- and digital-tape transports. Patch panel programing, special circuits, and power distribution and wiring are also described. I.v.L.

N64-29231 Michigan State U., East Lansing.
QUASI-MARTINGALES AND STOCHASTIC INTEGRALS
Donald L. Fisk 2 Aug. 1963 95 p refs
(Contract Nonr-2587(02))
(TR-1; AD-601859)

The (Ω, F, P) is a probability measure space on which is defined a family of real valued random variables (rv's) $[X(t); t\epsilon T]$ where T is a subset of the real line. It is always assumed that $E(|X(t)|) < \infty$ for every $t\epsilon T$. Let $[F(t); t\epsilon T]$ be a family of sub σ-fields of F with $F(s) \subset F(t)$ for every s, $t\epsilon T$ with $s \geq t$. The family of rv's $[X(t); t\epsilon T]$ is said to be well adapted to the family of sub σ-fields $[F(t); t\epsilon T]$ if X(t) is F(t) measurable for every $t\epsilon T$, and $[X(t), F(t); t\epsilon T]$ is written to indicate this relation. The family $[X(t), F(t); t\epsilon T]$ is referred to as a stochastic process. In many cases F(t) is the minimal σ-field with respect to which the family of rv's $[X(s); s\epsilon T, s \geq t]$ is measurable. A process $[X(t), F(t); t\epsilon T]$ is called a martingale process, if for every s, $t\epsilon T$ with $s \geq t$, $E(|X(t)|\ F(s)) = X(s)$ with probability one (a.s., a.e.), and is called a semimartingale (supermartingale) process if $E(|X(t)|\ F(s)) \geq X(s)$ a.s. $(E|X(t)|\ F(s)) \geq X(s)$ a.s.). The process $[X(t), F(t); t\epsilon T]$ is called a quasi-martingale process if there exists a martingale process $[X_1(t), F(t); t\epsilon T]$ and a process $[X_2(t), F(t); t\epsilon T]$ with a.e. sample function of bounded variation on T such that $P([X(t) = X_1(t)+X_2(t); t\epsilon T]) = 1$. Based on these premises and ensuing development, random stopping of the stochastic process and the decomposition of a quasi-martingale process are investigated. In addition, a stochastic integral for quasi-martingales is defined, using the limits in probability of Riemann–Stieltjes sums. I.v.L.

N64-29242 Hercules Powder Co., Cumberland, Md. Allegany Ballistics Lab.
NATURAL TRIGONOMETRIC FUNCTIONS OF SINE, COSINE, AND TANGENT FROM 0 TO 360 DEGREES IN INCREMENTS OF 0-0002 RADIAN
Oct. 1963 630 p
(Contract Nord-16640)
(ABL/X-111; AD-602892)

N64-29285 Naval Weapons Lab., Dahlgren, Va. Computation and Analysis Lab.
COMPUTING PROGRAMS FOR COMPLEX BESSEL FUNCTIONS
A. V. Hershey 7 Feb. 1964 138 p refs
(NWL-1906; NAVWEPS-8336; AD-445827)

The asymptotic series with converging factor is used in subroutines to evaluate conventional Bessel functions. Rational polynomial approximations are developed for the modified Bessel function of the second kind of orders zero, one-third, two-thirds, and one. The range of validity of the rational approximations is that part of the complex plane on the positive side that is bounded by the imaginary axis and by a circle of unit radius. Values of the modified Bessel function to 13 decimal digits are tabulated at unit intervals. Author

N64-29300 Wisconsin U., Madison Mathematics Research Center
TWO APPLICATIONS OF CHAIN SEQUENCES TO UNIVALENCE
T. L. Hayden and E. P. Merkes Feb. 1963 38 p refs
(Contract DA-11-022-ORD-2059)
(MRC-378; AD-401140)

By a reformulation of some classical results on chain sequences, necessary and sufficient conditions are obtained for each function

$F(z) = z/1 + \underline{a_1 z^\alpha}/1 + \underline{a_2 z^\alpha}/1 + \ldots$, where $|a_n| \leq k_n$, $n = 1, 2, \ldots$

and $\{k_n\}$ is a fixed chain sequence, to be univalent in the unit disk. Estimates of the starlike radius of the functions F(z) are found. The second application relates chain sequences to the radii of univalence and of starlikeness of a class of functions f(z) where the ratio $zf'(z)/f(z)$ has a certain type of C-fraction expansion. As an illustration of the result, the question of univalence and starlikeness of suitably normalized Bessel functions is considered. Author

N64-29308 Aberdeen Proving Ground, Md. Ballistic Research Labs.
THE ADDITION THEOREM FOR A DERIVATIVE OF A LEGENDRE POLYNOMIAL
Boris Garfinkel May 1964 14 p refs
(BRL-1248; AD-444778)

An expression is derived for the coefficient $b_k^{n,m}$ of the Fourier expansion,

$$P_n^{(m)}(\cos\gamma) = \sum_k b_k^{n,m} \cos k\phi ,$$

where

$$\cos\gamma \equiv \cos\theta_1 \cos\theta_2 + \sin\theta_1 \sin\theta_2 \cos\phi .$$

The expression, involving only a single summation, is useful in the potential theory and in the celestial mechanics of an artificial satellite. Author

N64-29309 Wisconsin U., Madison Mathematics Research Center
ON THE APPROXIMATE SOLUTION OF $\delta u = F(u)$
D. Greenspan and M. Yohe Mar. 1963 26 p refs
(Contract DA-11-022-ORD-2059)
(MRC-384; AD-401186)

Three-dimensional Dirichlet problems for $\Delta u = F(u)$, $F_u \geq 0$, are treated numerically by an exceptionally fast and accurate numerical method. Programing details, numerous examples, and mathematical theory are supplied. Extension of the method in a natural way to n-dimensional problems is indicated by means of a 4-dimensional example. Author

N64-29351 Harvard U., Cambridge Cruft Lab.
SOME INEQUALITY CONSTRAINT PROBLEMS IN THE CALCULUS OF VARIATIONS
Walter F. Denham 16 Apr. 1964 28 p ref
(Contract Nonr-1866(16))
(TR-436; AD-601842)

Four related memoranda dealing with inequality constraints in the calculus of variations collected in this report are as follows: (1) a detailed derivation of the solution to a problem; (2) the solution to the simplest possible problem including both a control variable and a state variable inequality constraint; (3) a slightly more complex problem leading to transcendental equations in the solution; and (4) a description of a straightforward method of calculating neighboring extremal paths when an interval of the nominal extremal is on a control variable or a first-order state variable inequality constraint boundary. Author

N64-29363* Boeing Co., Seattle, Wash. Aero-Space Div.
COMPUTER CODES FOR THE EVALUATION OF SPACE RADIATION HAZARDS, VOLUME 1
Maurice C. Wilkinson [1963] 152 p refs
(Contract NAS9-1393)
(NASA CR-58292; D2-90418-1) OTS: $11.50 ph

The computer codes developed for the evaluation of the absorbed dose in an astronaut's body are discussed. The Apollo vehicle is analyzed by these codes, and the absorbed dose at three body points is found for two lunar trajectories. In addition, the absorbed dose resulting from a solar flare is calculated. These dose results indicate that the geomagnetically trapped radiation does not constitute a significant hazard for either of the two trajectories considered. The solar flare considered results in absorbed doses ranging from 89 rads at the blood forming organ to 1,517 rads at the skin. Additional shielding will be required if a flare of this type is not to produce significant damage. Author

N64-29364 Boeing Co., Seattle, Wash. Aero-Space Div.
COMPUTER CODES FOR THE EVALUATION OF SPACE RADIATION HAZARDS. VOLUME 2: VAN ALLEN RADIATION
Wing Y. Wong [1963] 72 p
(Contract NAS9-1393)
(NASA-CR-58293; D2-90418-2) OTS: $7.60 ph

This program is an all-FORTRAN code, which computes the flux and the total time-integrated fluxes of protons and electrons for vehicle trajectories along the Van Allen radiation belt. For study purposes, this belt is differentiated into four separate belts: (1) high-energy proton belt, for protons with energy greater than 20 Mev; (2) low-energy proton belt, for protons with energy less than 20 Mev; (3) AFSWC threat electron belt, which is a theoretical belt; and (4) electron belt, as it existed on October 20, 1962. These belts are represented by spatial flux maps, which are read as inputs to the program.

These maps were constructed from empirical measurements received from satellites. Flux values are given as functions of B (magnetic flux density in gauss) and of L(McIlwain parameter in units of earth radii). Author

N64-29365* Boeing Co., Seattle, Wash. Aero-Space Div.
COMPUTER CODES FOR THE EVALUATION OF SPACE RADIATION HAZARDS. VOL. 3: APOLLO SECTOR ANALYSIS
Dale R. Ferguson [1964] 27 p refs
(Contract NAS9-1393)
(NASA-CR-58294; D2-90418-3) OTS: $2.60 ph

In order to determine if additional shielding against space radiation is necessary in certain areas of a spacecraft, a detailed sector analysis is required. The spacecraft's inherent radiation shielding for each sector, the body tissue thickness in each sector, and the fractional solid angle for each sector are inputs for computer programs that calculate the dose at a specified body point. Three body points were used, and the average tissue thickness for each solid angle was determined. Author

N64-29367* Boeing Co., Seattle, Wash. Aero-Space Div.
COMPUTER CODES FOR THE EVALUATION OF SPACE RADIATION HAZARDS. VOL. 5: ELECTRON MONTE CARLO
Karen S. McGarrigle and B. W. Mar [1964] 91 p refs
(Contract NAS9-1393)
(NASA-CR-58296; D2-90418-5) OTS: $8.60 ph

A Monte Carlo program was developed specifically for the problem of space radiation. The program, written for the IBM-7094 computer, consists of a main input program and several subroutines written in FORTRAN and FAP languages. Given the energy of electrons incident on a particular material or shield, the program permits the determination of the following: how many of the electrons penetrate the shield, their energy after penetration, and the energy deposition within the shield. Once these factors are known, the damage to objects behind the shield and the thickness of a particular shield, necessary to protect instruments or human beings, can be determined. I.v.L.

N64-29368* Boeing Co., Seattle, Wash. Aero-Space Div.
COMPUTER CODES FOR THE EVALUATION OF SPACE RADIATION HAZARDS. VOL. 6: ELECTRON TRANSMISSION
Charles T. Hawkins [1964] 28 p refs
(Contract NAS9-1393)
(NASA-CR-58297; D2-90418-6) OTS: $2.60 ph

The purpose of this program is to compute the space radiation dose caused by electrons being transmitted through a radiation shield. Required inputs for the program are electron flux to dose conversion table, energy spectrum being used, atomic number of shield material, and layer thickness for each solid angle for each sector. The program is presently set up to handle only one type of material at a time. Dose may be calculated at any point inside a vehicle. Author

N64-29369* Boeing Co., Seattle, Wash. Aero-Space Div.
COMPUTER CODES FOR THE EVALUATION OF SPACE RADIATION HAZARDS. VOL. 7: SPACE RADIATION DOSES FROM PRIMARY PROTONS
Raymond P. Moshofsky [1964] 37 p refs
(Contract NAS9-1393)
(NASA-CR-58298; D2-90418-7) OTS: $3.60 ph

Radiation environments in space include protons from solar flares and protons in the trapped radiation belt surrounding the earth. In order to evaluate the hazard to space systems arising from these protons, an IBM 7094 FORTRAN program has been developed. This program calculates the radiation dose to men or equipment located inside the space vehicle in such an environment. Required input data for these calculations include materials and their thicknesses observed from the dose point inside the vehicle, physical properties of the shield materials involved, and incident proton energy spectrum and angular distribution. Optionally, the program can compute the density of defects produced in semiconductor materials. This requires the additional input of points from a response function that converts proton flux to defect density. Author

N64-29370* Boeing Co., Seattle, Wash. Aero-Space Div.
COMPUTER CODES FOR THE EVALUATION OF SPACE RADIATION HAZARDS. VOL. 8: SPACE RADIATION DOSES FROM PROTONS AND THEIR SECONDARY RADIATIONS
Raymond P. Moshofsky [1959] 81 p refs
(Contract NAS9-1393)
(NASA-CR-58299; D2-90418-8) OTS: $8.10 ph

Described is an IBM 7090 FORTRAN program that calculates the primary proton dose and the dose from secondary protons, neutrons, and gamma rays produced by the interaction of the primary protons with materials. Included in the calculations is a method of considering the three-dimensional shielding configurations of space vehicles. Required data inputs to the machine program are: (1) properties of the shield materials relating to attenuation of nuclear radiation; (2) energy and angular distributions of the primary protons; (3) shield configuration in terms of materials and their thicknesses observed in every direction from a point of interest or dose point; and (4) properties of the shield materials relating to the production of the secondary radiation. Using this required data, the dose in human tissue is calculated. By considering human body tissue as part of the shielding, it is possible to evaluate doses at points inside the body. Author

N64-29385* Massachusetts Inst. of Tech., Cambridge Research Lab. of Electronics
EXPERIMENTS ON COMPUTER RECOGNITION OF CONNECTED HANDWRITTEN WORDS
Paul Mermelstein and Murray Eden Repr. from Inform. and Control, v. 7, no. 2, Jun. 1964 p 255-270
(Grants NSG-496; NIH MH-04737-04; NSF G-16526; Contract DA-36-039-AMc-03200(E))

An operational system is presented for the recognition of handwritten words when written on line on a special transducer. The system represents a new approach to handwriting recognition, that of searching for the invariants of the patterns by consideration of the intrinsic movements that execute the handwriting. The handwritten words are analyzed by segmentation into strokes, recognition of strokes by the statistical likelihood of their belonging to preselected classes, and the use of constraints inherent in the script and word representations to limit the output sequences generated. Experiments carried out by computer simulation of the recognition system reveal that the system is capable of recognizing well-formed, legible handwritten words with a reliability that depends on the correspondence between the script of the test samples and that of the ensemble on which the machine's representation of handwriting is based. Author

N64-29392 Research Triangle Inst., Durham, N.C.
ON THE MEAN NUMBER OF CURVE CROSSINGS BY NON-STATIONARY NORMAL PROCESSES

M. R. Leadbetter and J. D. Cryer Jul. 1964 16 p refs
(Contract Nonr-4565(00))
(TR-1; AD-602168)

This report considers the mean number of crossings of an arbitrary curve, in a given time T, by a nonstationary normal process. A formula is obtained for this, and sufficient conditions for its validity are given. These conditions concern the behavior of the covariance function of the normal process. Incidental results include sufficient conditions for continuity of a normal (nonstationary) process x(t), and also for x(t) to satisfy a Hölder condition. Author

N64-29396 Oak Ridge National Lab., Tenn.
A REACTIVITY COMPUTER FOR USE WITH NUCLEAR REACTOR CONTROL SYSTEM
L. C. Oakes Sep. 1964 49 p refs
(Contract W-7405-ENG-26)
(ORNL-3685) OTS: $1.25

An electromechanical analog computer for computing relatively slow changes in reactivity in a high-power-density thermal reactor is described. Analytic expressions in the form of differential equations describing fission product poisoning and fuel depletion are given. The analog computer has been designed to provide solutions to these differential equations. Design criteria are given. A functional block diagram and considerable design details of the computer are also given. Results of several tests indicate that the percentage of error in computed reactivity is no greater than 3.2. This maximum error occurred in an overall operating time of 8.85 hours. Author

N64-29425 Joint Publications Research Service, Washington, D.C.
DEVELOPMENT OF RESEARCH ON THE AUTOMATION OF PROGRAMMING
16 Sep. 1964 13 p ref Transl. into ENGLISH from Vestn. Akad. Nauk SSSR (Moscow), no. 5, 1964 p 19–26
(JPRS-26430; TT-64-41688) OTS: $1.00

Several reports dealing with the present state of automatic programing in the USSR are presented. A discussion of the reports is also included, and the need for more and continued research into automatic programing is affirmed. P.V.E.

N64-29432 Sylvania Electric Products, Inc., Waltham, Mass. Applied Research Lab.
RESEARCH IN NONLINEAR CODES Final Report
R. Turyn Mar. 1964 71 p refs
(Contract AF 19(628)-2479)
(F-3001-1; AFCRL-64-137; AD-433975)

This report deals with difference sets, subsets of a group with the property that any two translates are a fixed Hamming distance apart. When the group is cyclic, these correspond to sequences whose periodic autocorrelation function is two-valued. The groups considered are those that admit a large number of characters. Several nonexistence theorems are proved. These assert that if the parameters v and n of a difference set have factors in common, there are bounds on the order of the characters of the group. Also discussed are multipliers of difference sets and the existence of difference sets in elementary abelian groups. Author

N64-29434 Michigan State U., East Lansing
ON A METHOD OF CONSTRUCTION OF PARTIAL GEOMETRIES AND PARTIAL BOLYAI-LOBACHEVSKY PLANES Technical Report No. 5
Esther Seiden 4 Nov. 1963 5 p
(Contract Nonr-2587(02))
(RM-110; ES-6; AD-601873) OTS: $0.50

The purpose of this paper is to point out that any projective plane of even order, say 2h, possessing an oval set of points of 2h + 2 with no three on one line, generates two disjoint partial geometries. The dual of one of these partial geometries obtained by interchanging the roles of the points and the lines forms a B-L plane. Author

N64-29435 Harvard U., Cambridge, Mass. Cruft Lab.
IDENTIFICATION OF LINEAR DYNAMIC SYSTEMS
Yu-Chi Ho and Robert C. K. Lee (Honeywell Co.) 25 May 1964 32 p refs
(Contract Nonr-1866(16))
(TR-446; AD-601844)

A real-time computational scheme is presented for the identification of linear dynamic system parameters. The method is shown to be convergent under stochastic environment for arbitrary initial estimates of the system parameters. Experiments with second- and fourth-order systems further verify the practicality of the method. Applications of the approach to adaptive prediction and filter design are direct and obvious. Author

N64-29445 Aerospace Corp., Patrick AFB, Fla. Eastern Test Range Office
QLAP REQUIREMENTS, PART I Preliminary Report
M. L. Schauerman 21 Aug. 1964 81 p
(Contract AF 04(695)-469)
(TOR-469(A5126-10)-1; AD-445788)

The Quick Look Analysis Program (QLAP) is used to process formated PCM data tapes in conjunction with other source data to provide an early source of performance information for the vehicle's propulsion, guidance, control, electrical, and structural systems, and the vehicle's aerodynamic environment and external tracking system. The QLAP requirements were originally Gemini oriented, but will be revised to be applicable to both the Gemini and the 624A programs. This portion of the QLAP series of reports describes the processing of a formated PCM tape, in conjunction with calibration and configuration data, to produce an output in engineering units. This output will ultimately result in a binary tape of all parameters in engineering units, plots of engineering units data vs time, and tabulated listings of selected parameters. I.v.L.

N64-29450 Atomics International, Canoga Park, Calif.
ARGON MASS FLOWRATE COMPUTER
K. H. Kline 1 Aug. 1964 17 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-9745) OTS: $0.50

A simple analog computer was designed and constructed for the purpose of monitoring the argon mass flow through the piping system of the argon activation neutron flux monitor. The flowrate is proportional to the product of the absolute pressure and the differential pressure across the flowmeter. Accuracy of computations was limited only by the linearity and reproducibility of the transducers used. Author

N64-29605 Lincoln Lab., Mass. Inst. of Tech., Lexington
PARTIAL FRACTIONS AND ERROR-CORRECTING CODES Group Report
E. Weiss 6 Jul. 1964 19 p refs
(Contract AF 19(628)-500)
(ESD-TDR-64-3489; AD-602982) OTS: $1.00

derive the properties of linear recursive sequences and, in particular, of Bose–Chaudhuri codes. One of the novel features of this method is a new and transparent proof of the basic result of Mattson–Solomon. Author

N64-29606 Copenhagen U. (Denmark) Inst. of Mathematical Statistics
BAYESIAN SINGLE SAMPLING ATTRIBUTE PLANS FOR DISCRETE PRIOR DISTRIBUTIONS
A. Hald Jun. 1964 90 p refs
(Contract Nonr-62558-3073)
(TR-5; AD-602396)

This report presents a rather complete tabulation and discussion of the properties of a system of single-sampling attribute plans obtained by minimizing costs, under the assumptions that the costs are linear in p, that the fraction is defective, and that the distribution of lot quality is a double binomial distribution. In addition, the properties of the optimum plans are studied, with the purpose of deriving simple conversion formulas that will make it possible to find the optimum plan for an arbitrary set of parameters from a plan in the master table with a "corresponding" set of parameters. I.v.L.

N64-29647 Washington U., St. Louis, Mo. Computing Devices Research Lab.
THE MATRIC COMPUTOR Final Report, 15 Jun. 1963–15 Jan. 1964
Pierre M. Honnell [1964] 36 p refs
(Grant NSF 6P-1432)

A canonic form for the direct dialing of single transfer functions into the Matric Computor shown previously, recognized that such functions are in reality differential equations. This paper shows how the tandem connections of transfer functions, sometimes employed for compensation, can also be dialed directly in canonic form into the Matric Computor. Furthermore, if the second transfer function is the reciprocal of the first, then the original signal is recovered at the output of the second transfer function. Another example is a nonminimum phase network constructed by the noninteracting parallel connection of two separate transfer functions in the usual manner; this is also easily dialed into the Matric Computor. Author

N64-29665 RAND Corp., Santa Monica, Calif.
ON THE RIESZ REPRESENTATION THEOREM
Richard Bellman Jul. 1964 7 p ref OTS: $1.00
(Contract AF 49(638)-700; Proj. RAND)
(RM-4149-PR; AD-602329) OTS: $1.00

A variational technique is developed for obtaining a short proof of a famous result of F. Riesz, which states that any continuous linear functional, L(f), defined for the functions $f \epsilon L^2(0,1)$ has the form $L(f) = \int_0^1 gfdx$, where $g\epsilon L^2(0,1)$. It was found that $L(u) - \int_0^1 gudx = 0$ for all u. I.v.L.

N64-29687* Midwest Research Inst., Kansas City, Mo.
NONLINEAR DYNAMICS OF THIN SHELL STRUCTURES Quarterly Status Report No. 2, 15 Apr.–14 Jul. 1964
Y. L. Luke 31 Jul. 1964 5 p
(Contract NASr-63(07))
(NASA-CR-58571) OTS: $1.10 ph

An earlier mathematical treatment is continued. The values of the Padé approximants and the corresponding partial sums of the power-series solution are compared to the true solution for an equation earlier derived and further discussed here. A perturbation technique is presented to analyze the changes in the equation when a small amount of damping is included. D.E.W.

N64-29733 Joint Publications Research Service, Washington, D.C.
PROBLEMS OF CYBERNETICS, NO. 10, 1963
A. A. Lyapunov, ed. 10 Sep. 1964 446 p refs Transl. into ENGLISH of the Book "Problemy Kibernetiki, No. 10" Moscow, State Publishing House of Physical and Mathematical Literature, 1963
(JPRS-26341; TT-64-41600) OTS: $7.40

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15. THE CONFIGURATIONAL CHARACTERISTICS OF LANGUAGES A. V. Gladkiy p 386–402 refs
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N64-29734 Joint Publications Research Service, Washington, D.C.
ON COMPARING THE COMPLEXITY OF BLIND AND MINIMAL DISJUNCTIVE NORMAL FORMS
Yu. L. Vasil'yev *In its* Probl. of Cybernetics, No. 10, 1963 10 Sep.1964 p 1–97 refs (See N64-29733 21-20) OTS: $7.40

A disjunctive normal form (DNF) may be regarded as a scheme for a control system whose functioning is described by the corresponding function of the algebra of logic. The problem of constructing a minimal DNF is a partial case of the problem of synthesis of minimal schemes for such control systems. The DNF T is called blind if cancellation of any disjunctive term, or of any factor thereof, transforms T into DNF T^*, which is nonequivalent to T. A minimal DNF is blind, but a blind DNF is not necessarily minimal. This report deals with investigations directed to the difficulties arising in various stages of minimal DNF synthesis, and with methods that afford metrical (numerical) estimates. I.v.L.

N64-29736 Joint Publications Research Service, Washington, D.C.
INTRODUCTION TO INFORMATION DYNAMICS AS A BRANCH OF THE THEORY OF INFORMATION
V. Yu. Urbakh *In its* Probl. of Cybernetics, No. 10, 1963 10 Sep. 1964 p 161–178 refs (See N64-297303 21-20) OTS: $7.40

The theory of information arose at a definite stage in the development of the general theory of communication; therefore, its mathematical formulation was so constructed as to respond to the needs of the theory of communication. However, it appears that the mathematical basis of the information theory is inadequate for the solution of certain broader problems that have arisen. In order to solve such problems, a sufficiently general mathematical mechanism must be found. The presence of the well-known analogy between the amount of information and thermodynamic entropy suggests that such a general mathematical mechanism might be found in something analogous to that employed in thermodynamics. This report effects an analogy between the system (a communication system) of the theory of information and a thermodynamic system (a physical system). I.v.L.

N64-29737 Joint Publications Research Service, Washington, D.C.
RECKONING WITH THE CORRELATIONS BETWEEN LETTERS OF AN ALPHABET, IN COMPUTING THE AMOUNT OF INFORMATION IN A COMMUNICATION
V. Yu. Urbakh *In its* Probl. of Cybernetics, No. 10, 1963 10 Sep. 1964 p 179–189 refs (See N64-29733 21-20) OTS: $7.40

This report discusses the search for a mathematical description of the influence of interword correlation upon the amount of information that can be obtained per single letter in a sequence, in which correlation at distances up to r letters is taken into account. The basis of this description should be the simplest possible function of the correlation range. It can be verified that such a function cannot be arrived at either for entropies H_r or for their differences $H - H_{r-1}$, but that it is indeed possible for differences of the second order: $k_s = i_s - i_{s+1}$. For finite r, the following formula was derived:

$$i_r = i_1 \left(1 - a \sum_{s=1}^{r-1} 1/s^n g\right).$$

I.v.L.

N64-29738 Joint Publications Research Service, Washington, D.C.
SOME APPLICATIONS OF LINEAR PROGRAMMING METHODS TO THE THEORY OF COOPERATIVE GAMES
O. N. Bondareva *In its* Probl. of Cybernetics, No. 10, 1963 10 Sep. 1964 p 190–224 refs (See N64-29733 21-20) OTS: $7.40

This article is devoted to the application of linear inequality theorems to the problem of a solution for cooperative games with n players. The concept of coverings, which characterizes the coalition structure of a game, is introduced, and their properties are studied. The nucleus is studied (that is, the set of shares that is always contained in a solution, and which, when it exists, is in some sense a substitute for the solution). The necessary and sufficient conditions (in terms of coverings) for the existence of a nucleus of a game are demonstrated. Author

N64-29739 Joint Publications Research Service, Washington, D.C.
BOUNDARIES AND ESTIMATES FOR ABRIDGING THE SEARCH OF ESTIMATES
A. L. Brudno *In its* Probl. of Cybernetics, No. 10, 1963 10 Sep. 1964 p 225–241 (See N64-29733 21-20) OTS: $7.40

The bounds considered are those limits that make it impossible to analyze the position (the position encountered upon a study of the variants of the game) if its estimate exceeds those limits. The bounds cannot be determined in a unique manner. True estimates for all positions considered are obtained upon a second determination of the bounds, although it is only for the gain for the entire game that a precise estimate is made. If the game is played with "current information," for which the positions studied and the estimates made are recorded (e.g., for the case where they are encountered for a second time on the second branch of a game tree), then it is possible to employ bounds, but narrow bounds may not be employed. This report abridges the search of joints in a game tree, which is necessary for choosing an optimal variant of the first play and is also necessary in finding an optimal branch and the number b(A) equal to c(A)—the value of the game. Here b(A) is the value of the apex position and c(A) is the value of the apex joint. I.v.L.

N64-29740 Joint Publications Research Service, Washington, D.C.
ONE VARIANT OF THE STRUCTURE OF A DIGITAL MACHINE FOR THE REDUCTION OF PRINTED INFORMATION
A. A. Strogniy *In its* Probl. of Cybernetics, No. 10, 1963 10 Sep. 1964 p 242–261 refs (See N64-29733 21-20) OTS: $7.40

The operative memory unit (OMU) of a digital logic machine intended for the reduction of literal (printed information), (DLM), is described. This unit is in the form of a sequence of numbered single-digit binary cells. The formation of the

k-digit binary cells is effected by programing, prior to input, of the solution program for a given problem (or class of problems). The parameter *k* may assume several values that are different for the different parts of the OMU. The design of this memory unit affords the possibility for the formation of *nk*-digit binary cells from the initial *k*-digit cells by means of combining *n* successive cells into one. In addition, operation-system requirements of the DLM are discussed. I.v.L.

N64-29741 Joint Publications Research Service, Washington, D.C.
ESTIMATING THE ERROR OF BINARY MULTIPLICATION
V. M. Khrapchenko *In its* Probl. of Cybernetics, No. 10, 1963 10 Sep. 1964 p 262–281 ref (See N64-29733 21-20) OTS: $7.40

Arithmetical operations on digital computers are usually followed by rounding off the result. The magnitude of the error, which arises here, must be taken into account in fixing the number of digits needed for presenting the material for machine use. A number of methods of multiplication can be realized more economically, provided each product of the multiplier *A* and the multiplicand *B* is rounded off immediately. This report makes an estimate of the error of binary multiplication in the case of this sort of rounding off. The method employed involves computing the maximal and minimal of values of the error of the product *BA*, with known *n* and *p*. I.v.L.

N64-29743 Joint Publications Research Service, Washington, D.C.
ELEMENTS OF DEGENERATION IN THE BIOCHEMICAL CODE
V. A. Ratner *In its* Probl. of Cybernetics, No. 10, 1963 10 Sep. 1964 p 303–316 refs (See N64-29733 21-20) OTS: $7.40

This report deals with additional properties of the biochemical code that do not contradict the results of Ochoa and Nirenberg, and explain the data on mutations caused by nitrous acid. Emphasis is placed on the fact that, of the possible 37 ordered triads containing uracilides, Ochoa and Nirenberg established coding for only 24; the author, on the basis of data on yields of amino acids and mutations induced by nitrous acid, was able to establish coding for all of the 37 triads. I.v.L.

N64-29744 Joint Publications Research Service, Washington, D.C.
ON COMPILING AN OPTIMAL GRAPH OF OPERATIONS
Yu. V. Glebskiy and V. N. Shevchenko *In its* Probl. of Cybernetics, No. 10, 1963 10 Sep. 1964 p 421–428 refs (See N64-29733 21-20) OTS: $7.40

This paper is a study of the question of compiling an optimal graph for operations with *n* machine tools processing *m* varieties of parts, where the technological route of each type of parts may be as complex as desired. As distinct from other studies devoted to algorithmic questions, the idealized scheme adopted here to represent real industrial conditions exhibits the following features; (1) It is assumed that every operation on an individual part occupies an amount of time so small that the number of parts subjected to this or that operation can be represented in the form of a quantity that assumes any positive real values. (2) At any given moment, a machine tool can be switched from one operation to any other, provided this does not violate the condition that every part passes through corresponding operations in a preassigned sequence. (3) The time required for reloading the tool (shift from one operation to another) is neglected. Author

N64-29745 Joint Publications Research Service, Washington, D.C.
A STABLE SUPPLEMENT TO THE DEFINITION OF PARTIAL AUTOMATONS
V. I. Levenshteyn *In its* Probl. of Cybernetics, No. 10, 1963 10 Sep. 1964 p 429–439 refs (See N64-29733 21-20) OTS: $7.40

Stable automatons, for a limited time, eliminate the effect of malfunctions (in the input sequence and in the sequence of states) upon their subsequent operation. Since in the solution of certain problems, arbitrariness is permitted in supplements to the definition of a partial automaton, it is expedient to study the question of the possibility of a stable supplement. Given are the necessary and stable conditions for a stable supplement to the definition of partial automatons, and also a clarification of certain quantitative relationships associated with such a supplement. Author

N64-29763 Naval Air Development Center, Johnsville, Pa. Aeronautical Computer Lab.
SOME STATISTICAL CONSIDERATIONS IN HARMONIC ANALYSIS
R. C. Gulezian 15 Jun. 1964 22 p refs
(NADC-AC-6409; AD-602692) OTS: $0.50

This technical note discusses some very basic notions concerning the applicability of statistics to the analysis of stationary time series. The purpose of the note is to provide an introduction to the subject at an elementary level. A sequence of observations, $X_1, X_2, \ldots, X_T$, is regarded as being expressible as

$$X_t = \sum_{i=0}^{p} (A_i \cos \omega_i t + B_i \sin \omega_i t) + \xi_t,$$

where ξ_t is a normally distributed random variable with mean zero and constant variance. The general problem of estimating the parameters, A_i, B_i, ω_i, $i=1, \ldots, p$ and testing hypotheses concerning them is discussed for the very simple case where X_t can be written as

$$X_t = A_0 + A_1 \cos \omega_1 t + B_1 \sin \omega_1 t + \xi_t.$$

The results generalize to the more complicated model. Author

N64-29764 California U., Berkeley
AN EVOLUTION-TYPE SEARCH METHOD FOR CONVEX SETS
H. J. Bremermann and M. Rogson May 1964 26 p refs
(Contracts Nonr-3656(08); Nonr-222(85))
(AD-602903) OTS: $2.00

The new evolution-type search method for convex sets, discussed in this report, may be interpreted as follows. The genotype controls the line of development of an organism, and environmental factors and other constraints determine how far it will go. Given a convex polyhedron in the Euclidean space of *n* dimensions and given a hyperplane through the origin (called the cost plane), that does not intersect the polyhedron, the problem consists of finding a point in the (closed) polyhedron whose distance to the cost plane is minimal. Certain directions, rather than the coordinate vectors of feasible solutions, are evolved. (From a fixed given point in the polyhedron, families of directions are evolved.) One direction is selected at the end of a cycle of the new method. It is selected so that the line through the given point, in the direction in question, intersects the boundary of the polyhedron at a point of minimal cost. Several test problems, involving this new method, have been successfully run by means of a program written for the IBM-7090 computer in FORTRAN and, partly, in FAP. These runs are described. I.v.L.

N64-29765 RAND Corp., Santa Monica, Calif.
BIGGER COMPUTERS AND BETTER MATHEMATICIANS
Richard Bellman Feb. 1964 7 p refs Submitted for Publication
(P-2863)

The need for research into the problem of constructing digital computers 100 to 1,000 times as fast, and 1,000 to 1,000,000 times as large as far as rapid access storage is concerned, is discussed. P.V.E.

N64-29834 Parke Mathematical Labs., Inc., Carlisle, Mass.
MADCAP: MAMMOTH DECIMAL ARITHMETIC PROGRAM FOR THE PDP-1 COMPUTER Scientific Report No. 1
E. Myrvaagnes Jun. 1964 54 p
(Contract AF 19(628)-3826)
(AFCRL-64-510; AD-604350)

A multiple-precision floating-point arithmetic program, MADCAP, for the PDP-1 computer is described. The number of significant digits maintained during calculations can be varied easily to suit the user's requirements of speed vs accuracy. Programing in MADCAP's own source language is extremely simple. Author

N64-29913 Wisconsin U., Madison Mathematics Research Center
SOME FAMILIES OF COMPOUND AND GENERALIZED DISTRIBUTIONS
John Gurland Feb. 1963 31 p refs
(Contract DA-11-022-ORD-2059)
(MRC-TSR-380; AD-401218)

Compound and generalized distributions are discussed in the framework of contagious distributions. In particular, it is pointed out that the negative binomial may be regarded as a compound Poisson (using a gamma variable as the compounder) or as a generalized Poisson (using a logarithmic random variable as the generalizer). As an example of true contagion the negative binomial is also a limit of the distribution obtained through Polya's urn model. A formal relation between compound and generalized distributions is developed, utilizing a symbolic notation. Some natural extensions of the negative binomial through repeated compounding with a gamma distribution or through repeated generalizing with a logarithmic distribution are indicated. Author

N64-29942 Navy Electronics Lab., San Diego, Calif.
TABLES FOR THE SEQUENTIAL BINOMIAL TEST WITH DETECTION AND GENERAL APPLICATIONS
R. A. Worley 3 Dec. 1963 554 p
(NEL-1202)

Statistics that predict the behavior of a binomial sequential test (the error probability and the first two moments and distribution of sample size) are tabulated for a variety of parameter combinations. A set of tables with parameters in radix 8 is provided for use with simple sequential computing devices. Graphs and simple estimation procedures are given so that a suitable probability ratio test may be quickly constructed. Binomial quantization of a continuous variable for a probability ratio test is considered with emphasis on the detection of signals in noise. The quantization levels that minimize sample size have been determined for the normal, exponential, Rayleigh, and Rice distributions. Author

N64-29968 Douglas Aircraft Co., Inc., Newport Beach, Calif. Astropower Lab.
ADAPTIVE TECHNIQUES AS APPLIED TO TEXTUAL DATA RETRIEVAL Final Report
J. A. Daly et al Griffiss AFB, N.Y., RADC, Aug. 1964 231 p refs
(Contract AF 30(602)-3134)
(RADC-TDR-64-206; AD-605260)

Document screening is considered as the formation of a classification vector whose coordinates relate the pertinence of the document to various subject fields. This vector is the resultant of vectors assigned to key words and phrases in the document. Adaptive techniques are described that assign vectors to key words on the basis of their occurrence in a corpus of preclassified documents. The results of experiments, conducted to determine the accuracy with which these adaptive techniques approximate key word relevance vectors assigned by expert judgment, are presented. A statistical model was formulated for the analysis of the document screening device. The model is used to predict system error rates as a function of the document corpora, the obsolescence of the relevance vectors, the accuracy of the input device, and the variation of other system design parameters. Author

N64-30027* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THREE-DIMENSIONAL MULTIPLE BEAM ANALYSIS OF A SATURN I VEHICLE
James L. Milner 16 Jul. 1964 35 p refs
(NASA-TM-X-53098) OTS: $3.60 ph

A normal mode vibration analysis was made of a Saturn I vehicle using a newly developed lumped-parameter multiple-beam representation incorporating coupling of the center tank motion in pitch, yaw, and roll with the motions of the outer tanks. The analysis demonstrates the uncoupling of motions in pitch, yaw, and roll for a vehicle having a symmetrical distribution of mass and stiffness. A few cases of nonsymmetry were examined, and numerical results were obtained that show the effect of vehicle nonsymmetry on the natural frequencies of the vehicle. Author

N64-30030 Aeronautical Research Labs., Melbourne (Australia)
ERROR THEORY IN MATRIX ALGEBRA
J.-M. Souriau and R. Bonnard Sep. 1963 22 p refs Transl. into ENGLISH from Rech. Aeron. (Chatillon-sous-Bagneux), no. 19, Jan.–Feb. 1951 p 41
(ARL-TRANS-21)

Two theories, linearization and norms, provide upper bounds to errors in the result of a set of matrix calculations. As illustrations, their application to two key problems, inversion and spectral decomposition, are discussed. The problem is considered from a statistical viewpoint, introducing the concept of "imprecisely known" columns and variance tensor. This method makes it possible to solve completely the problem of calculation of mean square errors on quantities obtained from experimental results. Author

N64-30057 Stanford U., Calif. Computer Science Div.
THE QD-ALGORITHM AS A METHOD FOR FINDING THE ROOTS OF A POLYNOMIAL EQUATION WHEN ALL ROOTS ARE POSITIVE
Chr. Andersen 8 Jun. 1964 80 p refs
(Contract Nonr-225(37))
(CS9)

The highlights of this report are these: (1) treatment of the QD-scheme, symmetric functions, and some results from the theory of Hankel determinants; (2) some well-known relations expressing the elements of the QD-scheme by means of the Henkel determinants and the existence theorem (the means by which the existence of a positive constant c such that $H_n^k > c$ (Positive roots) may be proved; (3) treatment of the question of convergence of the columns of the QD-scheme and the development of an exact expression for q^k for the case of different roots; (4) a detailed examination of the convergence to the smallest root and the development of an exact expression for q^N, which is correct in all cases of multiple positive roots; (5) demonstration that the progressive form of the QD-algorithm is only "mildly unstable;" and (6) some ALGOL programs and some results obtained by them. In addition, the practical use of the QD-algorithm as a general rootfinder (e.g., in numerical experiments with real polynomials with complex roots) is discussed. I.v.L.

N64-30084* Illinois U., Urbana
GEOMETRICAL AND INERTIAL PROPERTIES OF A CLASS OF THIN SHELLS OF REVOLUTION
Will J. Worley and Han-chung Wang Washington, NASA, Sep. 1964 212 p refs
(Grant NsG-434)
(NASA-CR-89) OTS: $3.50

This report is concerned with the evaluation of line integrals, surface integrals, volumes, centroids of volumes and moments of inertia for thin walled shells of revolution. The shells are defined by revolving the first quadrant of $\left|\frac{x}{a}\right|^{\alpha} + \left|\frac{y}{b}\right|^{\beta} = 1$ about the X-axis, where a, b, α and β are positive constants. The exponents range from 0.2 to 10 with 15 values of each leading to two hundred and twenty-five configurations. Values of the above quantities are tabulated for one quarter, one half, three quarters, and a full cap or quadrant. The computation, using Simpson's rule and performed on an IBM-7094 digital computer, consists of five place accuracy tables in floating point notation. The corresponding characteristics of solid bodies of revolution are discussed. Author

N64-30107 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
NORMAL ALGORITHMS AND RECURRING FUNCTIONS
V. K. Detlovs 14 Jul. 1964 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 90, no. 5, 1953 p 723–725
(FTD-TT-64-276/1; AD-603328)

It is shown that each partial recursive function of $\underline{n}$ arguments is algorithmic and that each general recursive function of $\underline{n}$ arguments is fully algorithmic. Conversely, it is proven that each algorithmic function of $\underline{n}$ arguments is a partial recursive function, and that each fully algorithmic function of n arguments is a generally recursive function. E.W.

N64-30113 Stanford U., Calif.
AN OBSTACLE-COURSE PROBLEM: I
Joseph Kadane 30 Jul. 1964 17 p
(Contract Nonr-225(52))
(TR-98; AD-604439)

An obstacle course is presented in which n obstacles are given, together with p_i, the probability of successfully overcoming the i^{th} obstacle ($0 < p_i < 1$), and $v_i > 0$, the value of overcoming it, for each obstacle $i = 1,2, \ldots, n$. A runner is permitted to choose $r \leq n$ (r fixed) obstacles and to order them, so that he maximizes his expected value, on the assumption that once he fails to overcome an obstacle he receives only the points previously earned. Author

N64-30141 Space Technology Labs., Inc., Redondo Beach, Calif. Physical Research Div.
UNIFIED METHOD FOR SOLVING GENERAL BOUNDARY VALUE PROBLEMS IN LINEAR ORDINARY SYSTEMS
Glen J. Culler Nov. 1963 46 p refs
(Contracts Nonr-233(24); DA-04-495-ORD-559)
(Rept.-9816-6001-RU-000; AD-602895)

The general boundary value and, respectively, the eigenvalue problem with which this report is concerned is of the form $P(y) = Bf$; $P(y) = \lambda By$; $My(a) + Ny(b) = 0$, where P is a nonsingular matrix differential expression, and M and N are matrices of constants. The problem can be restricted to $P = D - A$, provided the basic concepts concerning boundary-value problems are invariant with respect to appropriate equivalence transformations of P. One way to achieve this invariance is to cast all problems in a standard form and construct the definitions for equivalence classes, and to show that all prior definitions are consistent with these. The usual way of writing the general problem is (1) $y' = Ay + Bf$; $My(a) + Ny(b) = 0$ and (2) $y' = Ay + \lambda By$; $My(a) + Ny(b) = 0$, where A and B are matrices of functions (real or complex) continuous on [a,b] and M and N are constant matrices. The properties of system (2), which justify expansion theorems analogous to those well known for other problems, have not so far been clearly classified and analyzed. They seem to depend primarily upon the character of the matrix of functions $B_{jk}(x)$. With this in mind, a theory is constructed for the isometric problems and is applied to secure results pertaining to the above-mentioned properties. I.v.L.

N64-30176 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
MATHEMATICAL LOGIC AND NUMERICAL ANALYSIS
A. A. Markov 15 Jul. 1964 10 p Transl. into ENGLISH from Vest. Akad. Nauk SSSR (Moscow), v. 27, no. 8, 1957 p 21–25
(FTD-TT-64-500/1, AD-603331)

The relationship between mathematical logic and numerical analysis is discussed. The author defines mathematical logic as the science that studies proof, and is therefore concerned with methods and the means of their construction. Numerical analysis is the "carrying through" of mathematical computations. One of the basic relationships between logic and analysis is the concept of the algorithm, which is discussed at length. A.W.

N64-30181 Washington U., Seattle
ALGEBRAIC ASPECTS OF PROLONGATIONS
Harold H. Johnson Jul. 1964 8 p refs
(Contract Nonr-477(15))
(TR-22; AD-603122) OTS: $1.00

The Cartan function, one of the algebraic structures that contain such information as the characters in the theory of exterior differential systems, is studied. All manifolds, functions, and forms considered are infinitely differentiable. The Cartan function is defined, and its total prolongation is derived. A theorem is presented: If S is a normal differential system on an open set M in R^{p+q+r} generated by $\theta_\rho = dz_\rho + A_\rho^\lambda dy_\lambda + B_\rho^j dx_j$, $\rho = 1,\ldots,r$ and having integral elements, then the Cartan function of its total prolongation is the total prolongation of its Cartan function. Further analysis indicates that it would be impossible to deduce the Cartan function for a partial prolongation from the Cartan function of the initial system. M.P.G.

N64-30182 Remington Rand Univac, St. Paul, Minn.
DIGITAL COMPUTER ADDRESSING METHODS
Jul. 1964 105 p
(Contract AF 04(694)-433)
(EF-3765-4; AD-603119) OTS: $4.00

Various addressing possibilities and their consequences to computer capabilities are identified and defined or illustrated to permit choice of an optimum addressing scheme for the Preferred Design for the Missile Guidance Computer. Other topics discussed include input–output addressing methods, address modification and indexing, bootstrap addressing, control memory addressing, instruction–operand memory, and addressing of instructions and operands in memory.

D.E.W.

21 METEOROLOGY

Includes climatology; weather forecasting; and lower atmosphere studies. *For related information see*: 05 Astronomy and Astrophysics; 12 Geophysics; and 29 Space Sciences.

N64-29082 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
DETERMINATION OF THE STATISTICAL CHARACTERISTICS OF RADIATION FIELDS ABOVE CLOUDS
M. S. Malkevich, I. P. Malkov, L. A. Pakhomova, G. V. Rozenberg, and G. P. Faraponova *In its* Cosmic Res., v. 2, no. 2 8 Jun. 1964 p 131–147 refs (See N64-29076 21-01)

The possibility of applying statistical analysis to fields of departing radiation, for the determination of cloud formation structures, is studied. Calculation of the structural parameters of cloud cover is carried out on the basis of aircraft measurements of radiation with narrow-angle and wide-angle instruments. Author

N64-29177* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
CAPE KENNEDY LOW LEVEL WIND STUDY FOR SEPTEMBER 23–25, 1963
Carroll Hasseltine 10 Apr. 1964 28 p refs
(NASA-TM-X-53027) OTS: $2.60 ph

This report compares the high winds recorded at Cape Kennedy, September 23 to 25, 1963, with the previously computed 95, 99, and 99.9 percentile wind speeds used for design criteria at Cape Kennedy and vicinity. Methods used in computing the wind speeds at Cape Kennedy are explained. Data are presented for the length of time that these percentile wind values were exceeded. A comparison of the constants describing the wind speed profiles for different wind speeds and a comparison of gust factors are also presented. Some of the computed constants that best describe the characteristics of high surface winds are shown to differ from the constants that best describe the entire spectrum of wind speeds. Author

N64-29372 Meteorology International Inc., Monterey, Calif.
A TEST OF THE DIAGNOSTIC-CYCLE ROUTINE Final Report
Manfred M. Holl, James R. Clark, and Roland E. Nagle 1 May 1964 90 p refs
(Contract Cwb-10561)
(AD-602107) OTS: $2.25

The diagnostic-cycle routine is an assembly of techniques that has been designed for the assimilation, intercomparison, and interpretation of meteorological observations of interrelated distributions, including satellite videographs. The present report describes a test of the routine as applied to a space–time region, which is well documented by satellite videographs and other data. The cloudiness distributions are analyzed, primarily by assembly of the available videographs, for three map-times defining two 24-hr periods. The evolution of the required mass-structure parameters is developed for a selected isentropic surface; the routine diagnoses the horizontal-velocity evolution and the three-dimensional net displacement of the layer of parcels for each of the two 24-hr periods. The observed changes in the cloudiness are interpreted in terms of the diagnosed air displacements. Author

N64-29376 American Meteorological Society, Boston, Mass.
SOME MEANS OF CONTROLLING CLIMATE [NEKOTORYE PUTI VOZDEISTVIIA NA KLIMAT]
M. I. Budyko Apr. 1964 13 p refs Transl. into ENGLISH from Meteorol. i Gidrol. (Moscow), no. 2, 1962 p 3–8
(Contract AF 19(628)-3880)
(T-R-435; AD-602195)

Proposed methods and method in practice for controlling climate are discussed. Included are these: (1) the transformation of cold climatic zones into warm ones by relocating production processes in which manmade power (e.g., atomic energy) is transformed into heat; (2) artificial stimulation of precipitation by seeding with dry ice and other reagents; (3) the modification of the precipitation regime by changing the state of the underlying surface, including changing the total evaporation; (4) direct control of air currents in order to alter the paths of air masses; (5) the scattering of fine dust particles in the atmosphere to change the radiant fluxes; (6) modification of the atmospheric-electric processes; and (7) the destruction of the Arctic ice cover that could lead to the reestablishment of preglacial condition, by changing the albedo of the ice surface or through the application of monomolecular films (which would reduce evaporation) to the water surface. I.v.L.

N64-29422 National Aeronautical Lab., Bangalore (India)
A STUDY OF THE HOURLY WIND SPEEDS AT GOPALPUR FROM THE POINT OF VIEW OF WIND POWER UTILIZATION
S. Janardhan and S. Viswanath May 1963 24 p ref
(TN-WP-27-63)

The hourly wind speeds at Gopalpur, recorded by a Dines' pressure-tube anemograph, were used to study frequency distribution, estimate the energy extractable from wind by a windmill under certain assumptions, and also to examine such characteristics of the wind as diurnal variation and spells of low wind. The annual mean wind speed at Gopalpur is 13 km/hr. The annual energy output of a wind electric generator of rotor area 30 m^2 and a uniform overall power coefficient of 12% is 3,640 kwh. The average quantity of water that can be pumped in a year by a WP-2 type windmill has been estimated at about 106,600 kl, i.e., 290 kl per day. Author

N64-29428 American Meteorological Society, Boston, Mass.
CONCERNING THE ACCURACY OF DETERMINING THE POSITION OF THE TROPOPAUSE [O TOCHNOSTI OPREDELENIIA POLOZHENIIA TROPOPAUZY]
Iu. N. Volkonskii Bedford, Mass., AFCRL, Dec. 1963 6 p Transl. into ENGLISH from Problemy Arktiki (USSR), no. 3, 1958 p 109–110
(Contract AF 19(604)-6113)
(T-R-421; AD-602148)

The determination of the variation of the height of the tropopause on the basis of radiosonde data inevitably involves random errors. In this report, a method is developed for determining the magnitude of these random errors. The data of an accelerated program of radio sounding (24-hour series with sondes released in the Leningrad area every 2 hours, 2 series a month) were used to calculate the average variation of the height of the tropopause at 0200, 0400, 0600, 0800, 1000, and 1200 hr. As was expected, when the interval $\Delta\tau$, for which the variation was calculated, decreased, the mean value of the interval also decreased. However, by extrapolating the variability curve, it can be readily seen that when $\Delta\tau \to 0$, $|\overline{\Delta H}|$ approaches a limit that differs substantially from zero. Quantity $\lim_{\Delta\tau \to 0} |\overline{\Delta H}| = 390$ km, and this was taken as the approximate value of the mean random error. I.v.L.

N64-29436 Bonn U. (W. Germany) Meteorological Inst.
INVESTIGATIONS ON THE TROPICAL EASTERLY JET Final Report
Hermann Flohn [1964] 86 p refs
(Contract DA-91-591-EUC-2781)
(FR-1; AD-602498) OTS: $3.00

During the northern summer, the tropical easterly jet (TEJ) extends in the layer 200–100 mb in the latitude belt 5° to 20° N from the Philippines across Southern Asia and Northern Africa to the Western Atlantic. The climatology, temperatures, dynamics, and role of the jet in atmospheric circulation are discussed. Remarks on the synoptic behavior of the tropical easterly jet are also included. D.E.R.

N64-29444 American Meteorological Society, Boston, Mass.
CONTROL OF METEOROLOGICAL PROCESSES [VOPROSY VOZDEISTVIIA NA METEOROLOGICHESKIE PROTSESSY]
A. M. Gusev Apr. 1964 6 p Transl. into ENGLISH from Vestnik, Akad. Nauk SSSR, no. 11, 1962 p 135–136
(Contract AF 19(628)-3880)
(T-R-438+; AD-602192)

Reports on the following are discussed: (1) frost protection of crops; (2) problems of climate amelioration by modifying the snow cover; (3) altering meteorological conditions by modifying the radiation regime; (4) a calculation of the possible mechanical effect that a considerable number of helicopters, providing a powerful downdraft, would have on an airmass; (5) climate control based on the assumption that the ice of the Arctic basin is relict, a remnant of the last glacial epoch; (6) the complex relations of climate to natural landscapes; (7) the problem of forecasting atmospheric phenomena in connection with artificial modification; and (8) work being conducted at the Institute of Applied Geophysics to develop a physical model of climate. I.v.L.

N64-29447 Air Weather Service, Washington, D.C.
ON THE ORIGIN AND CLIMATOLOGY OF NOCTILUCENT CLOUDS
R. S. Quiroz 1 Aug. 1964 32 p refs
(TR-181; AD-446389)

The existing concepts of the constitution or origin of the clouds are reviewed, and a mechanism is suggested that might explain their apparent dependence on latitude. Their frequency of occurrence with respect to latitude, longitude, time of year, and other factors, is analyzed in detail. Year-to-year changes in the number of occurrences are considered in relation to the 11-year sunspot cycle. A comprehensive sample of data on cloud movement is summarized. A comparison is made of rocket samples of particle size and concentration with values deduced from polarization measurements. Author

N64-29504* Colorado State U., Fort Collins
INVESTIGATIONS OF THE TEMPERATURE AND SPECTRAL EMISSIVITY CHARACTERISTICS OF CLOUD TOPS AND OF THE EARTH'S SURFACE First Semiannual Progress Report, May 1963–Feb. 1964
William E. Marlatt Feb. 1964 92 p refs *Its* Tech. Paper 51
(Contract NASr-147)
(NASA-CR-58346) OTS: $8.60 ph

The basic objectives of the study were as follows: (1) to investigate the relationship between actual earth-surface temperature and the temperature of cloud tops and the observed temperatures of these surfaces, as measured by radiometers aboard aircraft and meteorological satellites; (2) to provide ground and low-level aircraft support for field studies conducted by the National Aeronautics and Space Administration; (3) to investigate the relationship between cloud-top radiation and the air temperature outside the cloud at cloud-top height; (4) to investigate the spectral emissivity characteristics of various cloud types and of the surface of the earth in desert, grassland, and forested regions. During the period covered by this report, primary emphasis has been placed on objectives (1) and (2). Author

N64-29528 Canadian Armament Research and Development Establishment, Valcartier
FLIGHT TEST RESULTS OF SEEDING FIRINGS (BB I-08 AND 09) AT FORT CHURCHILL, MANITOBA
R. C. Brereton Jun. 1964 12 p refs
(CARDE-TN-1587/64)

Two Black Brant I rockets (BB I-08 and 09) were fired in order to conduct seeding experiments in the upper atmosphere. The nose cone is described, and the techniques employed in the experiment are detailed. Launch data and flight results are presented. Failure of a clock in the first vehicle (BB I-08) caused complete loss of the experiment. The second vehicle appeared to function normally; however, no cloud of released gas was observed. Author

N64-29531 Wisconsin U., Madison
STUDIES OF THE EFFECTS OF VARIATIONS IN BOUNDARY CONDITIONS ON THE ATMOSPHERIC BOUNDARY LAYER Annual Report 1963
Heinz H. Lettav et al Nov. 1963 36 p refs
(Contract DA-36-039-AMC-00878)
(AD-429496)

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1. A CRITICAL INVESTIGATION OF THE UNIVERSALITY OF KARMAN'S CONSTANT IN TURBULENT FLOW L. S. Slotta p 1–36 refs (See N64-29532 21-11)
2. CLIMATOLOGY OF AERODYNAMIC ROUGHNESS PARAMETER AND ENERGY DISSIPATION IN THE PLANETARY BOUNDARY LAYER OF THE NORTHERN HEMISPHERE E. C. Kung p 37–96 refs (See N64-29533 21-21)
3. THE MODIFICATION OF TEMPERATURE VARIANCE SPECTRA IN AIRFLOW OVER ARTIFICIALLY CONTROLLED SURFACE ROUGHNESS J. P. Kearns and R. J. Deland p 97–113 refs (See N64-29534 21-21)

4. REPORT ON TWO WIND-PROFILE MODIFICATION EXPERIMENTS IN AIRFLOW OVER THE ICE OF LAKE MENDOTA C. R. Stearns and H. H. Lettau p 115–138 refs (See N64-29535 21-21)

5. PRELIMINARY NOTE ON THE THEORY OF STEADY KATABATIC FLOW FOR HEIGHT-DEPENDENT EDDY DIFFUSIVITY H. H. Lettau p 139–149 refs (See N64-29536 21-21)

N64-29533 Wisconsin U., Madison

CLIMATOLOGY OF AERODYNAMIC ROUGHNESS PARAMETER AND ENERGY DISSIPATION IN THE PLANETARY BOUNDARY LAYER OVER THE NORTHERN HEMISPHERE

Ernest Chew-Tsun Kung *In its* Studies of the Effects of Variations in Boundary Conditions on the Atmospheric Boundary Layer Nov. 1963 p 37–96 refs (See N64-29531 21-21)

With the aid of an empirical numerical relationship between vegetation height and aerodynamic roughness length z_0, and the results of a land-use survey, meridional profiles of z_0 for all continents, and regional–seasonal variations over the North American Continent were derived between latitudes 25° and 70° N. The representativeness of the derived z_0 values was tested, using climatological data on the ratio of wind speed at anemometer level to geostrophic speed. Utilizing the concept of the geostrophic drag coefficient and its dependency on the surface-Rossby number, basically micrometeorological parameterization was applied to the large-scale problem of computing energy dissipation in the planetary boundary layer. Author

N64-29534 Wisconsin U., Madison

THE MODIFICATION OF TEMPERATURE VARIANCE SPECTRA IN AIRFLOW OVER ARTIFICIALLY CONTROLLED SURFACE ROUGHNESS

Joan P. Kearns and Raymond J. Deland *In its* Studies of the Effects of Variations in Boundary Conditions on the Atmospheric Boundary Layer Nov. 1963 p 97–113 refs (See N64-29531 21-21)

Temperature spectra were measured over a field of bushel baskets set on the frozen surface of Lake Mendota, and also over the unmodified ice surface. Comparison of the spectra shows the effects of turbulence generated by the bushel-basket field as a whole and by the spacing of the bushel baskets. Author

N64-29535 Wisconsin U., Madison

REPORT ON TWO WIND PROFILE MODIFICATION EXPERIMENTS IN AIR FLOW OVER THE ICE OF LAKE MENDOTA

Charles R. Stearns and Heinz H. Lettau *In its* Studies of the Effects of Variations in Boundary Conditions on the Atmospheric Boundary Layer Nov. 1963 p 115–138 refs (See N64-29531 21-21)

Two different wind-profile-modification experiments in airflow over the ice of Lake Mendota were made in March of 1963. In the first experiment, an array of conifer saplings (Christmas trees) and in the second, adjacent fields of black and white bushel baskets were employed. Wind-profile modification was measured with the aid of a moving and a stationary anemometer mast. An analysis of the results is presented primarily in terms of horizontal momentum budgets, as a function of wind fetch across and downwind of the obstacle fields. The efficiency of obstacles, when expressed in specific terms of momentum extraction per unit silhouette area, is about twice as large for trees in comparison to bushel baskets, and slightly, but significantly, larger for black in comparison with white bushel baskets, with solar heating being present. Author

N64-29536 Wisconsin U., Madison

PRELIMINARY NOTE ON THE THEORY OF STEADY KATABATIC FLOW FOR HEIGHT-DEPENDENT EDDY DIFFUSIVITY

Heinz H. Lettau *In its* Studies of the Effects of Variations in Boundary Conditions on the Atmospheric Boundary Layer Nov. 1963 p 139–149 refs (See N64-29531 21-21)

The classical theory of katabatic flow, as first presented by Prandtl, is reviewed; it is essentially a laminar-flow solution for constant viscosity and heat conductivity. The characteristic equations of katabatic flow for height-dependent eddy diffusivity are derived; it is demonstrated that the mathematical problem is similar to that of spiral-flow in the planetary boundary layer of a barotropic atmosphere. Possibilities of model solutions are discussed. Author

N64-29645 Illinois State Water Survey, Urbana Meteorologic Lab.

INVESTIGATION OF THE QUANTITATIVE DETERMINATION OF POINT AND AREAL PRECIPITATION BY RADAR ECHO MEASUREMENTS Ninth Technical Report, 1 Oct. 1963–31 Mar. 1964

A. L. Sims, E. A. Mueller, G. E. Stout, and T. E. Larson [1964] 55 p refs

(Contract DA-36-039-SC-87280)

(TR-9; AD-602744)

The operational programs for the radars and raindrop cameras are proceeding normally. The M-33 acquisition radar is being used with step gain, at present. The drop cameras have been installed but are not yet ready for data collection. The proposal for measuring radar attenuation and reflectivity to determine rainfall rate is investigated and found to yield no significant gain in estimate reliability. A method for attenuation correction is proposed and evaluated. Author

N64-29666 Joint Publications Research Service, Washington, D.C.

HYDRODYNAMIC LONG-RANGE WEATHER FORECASTING

27 Aug. 1964 57 p refs Transl. into ENGLISH from Gidrodinamicheskiy Dolgosrochnyy Prognoz Pogody (Moscow), 1964 (JPRS-26176; TT-64-41435) OTS: $3.00

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1. ON A HYDRODYNAMIC THEORY OF CLIMATE AND LONG-RANGE WEATHER FORECASTING Ye. N. Blinova p 1–19 refs (See N64-29667 21-21)

2. FORECASTING ZONAL CIRCULATION ON THE BASIS OF COUPLING MOMENTS M. B. Galin p 20–30 refs (See N64-29668 21-21)

3. ON THE DISTRIBUTION OF PRESSURE-FIELD COUPLING MOMENTS IN A STANDARD LAYER OF THE ATMOSPHERE I. P. Smirnov p 31–43 refs (See N64-29669 21-21)

4. ON FORECASTING ZONAL CIRCULATION FOR A LONG PERIOD I. P. Smirnov p 44–53 refs (See N64-29670 21-21)

N64-29667 Joint Publications Research Service, Washington, D.C.

ON A HYDRODYNAMIC THEORY OF CLIMATE AND LONG-RANGE WEATHER FORECASTING

Ye. N. Blinova *In its* Hydrodyn. Long-Range Weather Forecasting 27 Aug. 1964 p 1–19 refs (See N64-29666 21-21) OTS: $3.00

A specific scheme is proposed for solving the system of differential equations previously presented by the author for long-range forecasting of meteorological elements. These equations are used together with both the aperiodic processes that describe the initial data and the climatic processes that have an annual period. M.P.G.

N64-29668 Joint Publications Research Service, Washington, D.C.
FORECASTING ZONAL CIRCULATION ON THE BASIS OF COUPLING MOMENTS
M. B. Galin *In its* Hydrodyn. Long-Range Weather Forecasting 27 Aug. 1964 p 20–30 refs (See N64-29666 21-21) OTS: $3.00

A particular case of forecasting smoothed values of meteorological elements is considered. First, the problem of forecasting the smoothed values of the field of the current function is analyzed without refining the form of the smoothing function. Then the zonal distribution of the flow function is obtained from the total field of this function by smoothing the latitude circles. It is demonstrated that there is no need to forecast individual azonal perturbations in predicting changes in zonal circulation. M.P.G.

N64-29669 Joint Publications Research Service, Washington, D.C.
ON THE DISTRIBUTION OF PRESSURE-FIELD COUPLING MOMENTS IN A STANDARD LAYER OF THE ATMOSPHERE
I. P. Smirnov *In its* Hydrodyn. Long-Range Weather Forecasting 27 Aug. 1964 p 31–43 refs (See N64-29666 21-21) OTS: $3.00

Two-point coupling moments (correlation functions) are used to examine the statistical characteristics of atmospheric motions on a planetary scale. A number of examples of constructing coupling moments for specific cases of real fields of the meteorological elements are considered. M.P.G.

N64-29670 Joint Publications Research Service, Washington, D.C.
ON FORECASTING ZONAL CIRCULATION FOR A LONG PERIOD
I. P. Smirnov *In its* Hydrodyn. Long-Range Weather Forecasting 27 Aug. 1964 p 44–53 refs (See N64-2966 21-21) OTS: $3.00

The problem of forecasting zonal circulation is refined by considering the change in the circulation index as a function of altitude. A comparison of climatic 70-day mean values of the circulation index with the 70-day values that actually occurred showed a satisfactory coincidence of the calculated and actual values. M.P.G.

N64-29713 Argentina Comision Nacional de Energia Atomica, Buenos Aires
CONSTRUCTION AND DETAILED SETTING OF A SYSTEM FOR THE PRECISE MEASUREMENTS OF THE AVERAGE DIFFUSION OF X-RAYS IN THE ABSOLUTE SCALE [CONSTRUCCION Y PUESTA A PUNTO DE UN SISTEMA PARA MEDIDAS PRECISAS DE DIFUSION CENTRAL DE RAYOS X EN ESCALA ABSOLUTA]
Alberto F. Bonfiglioli 1964 14 p refs In SPANISH *Its* Informe No. 111 Partially Sponsored by Comm. a l'Energia Atomique (France)

A method of determining the average diffusion of X-rays by a goniometer is described. The method, operating with monoderomatic radiation, permits determination of the absolute average of diffusion with great precision. The construction details and operation parameters of the apparatus are given. Trans. by D.E.R.

N64-29758 Joint Publications Research Service, Washington, D.C.
WEATHER AND FLIGHT SAFETY [POGODA I BEZOPASNOST' POLETOV]
I. Nikolayev and V. Netesov 23 Sep. 1964 7 p Transl. into ENGLISH from Krasnaya Zvezda (Moscow), 31 Jul. 1964 p 2 (JPRS-26524; TT-64-41782) OTS: $1.00

The efficient organization of flights, the proper performance of training assignments, and, most important, the safety of flights greatly depend on well-organized meteorological services that have become an integral part of the Air Force military operations. In the U.S.S.R., outstanding commanders concentrate heavily on the meteorological training of aircrews. These commanders give practical advice as to what to do in cases of complicated weather conditions; they hold regular seminars on the study of local weather conditions and their characteristics; and they take into account the advice of weather forecasters and never neglect their sound reasoning. Thus, no accidents occur in their units that are due to meteorological conditions, and there are no reasons to anticipate them. However, not all commanding officers understand the importance of meteorological services. These officers take the stand that aircraft are equipped with such excellent devices that no weather presents a hazard to the airplane. I.v.L.

N64-29795 Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J.
CORRELATION BETWEEN ATMOSPHERIC BACK-SCATTERING AND METEOROLOGICAL VISUAL RANGE
Robert W. Fenn Jun. 1964 21 p refs
(USAEL-TR-2481; AD-604255)

On the basis of present knowledge of the distribution of natural haze particles in the atmosphere, the relation between the backscatter intensity and the visual range on the extinction coefficient has been analyzed. The various processes that cause the changes in visibility (increasing haze-particle number, change in haze particle-size distribution, etc.) result in rather different backscatter conditions. Therefore, it cannot be expected that a unique relation between visibility and backscatter signal can be found. A relation, visibility = f(backscatter signal), with useful accuracy, can be established only for specific atmospheric conditions; this relation, however, may be characteristic for certain geographical areas. These conclusions, derived from natural aerosol distributions and processes, are found to be in agreement with some published empirical data on scattering and visibility correlation. Author

N64-29860 Naval Ordnance Lab., White Oak, Md. Underwater Explosions Div.
RECTIFICATION OF OBLIQUE PHOTOGRAPHS TO OBTAIN BASE SURGE CONTOURS
D. E. Phillips Sep. 1964 18 p
(NOLTR-64-91; AD-603252)

Rectification of oblique aerial photographs is one means used to obtain contours of the base surge formed by an underwater nuclear explosion. An analytic photogrammetric method of rectification, based on the visible horizon and altitude of the photo aircraft, is described. This method gives the position of any point on the photograph in terms of its coordinates on

a rectangular grid system on the water surface. The supplemental information needed to rectify an oblique photograph is discussed. Author

N64-29882 National Aeronautical Lab., Bangalore (India)
OBSERVATIONS IN INDIA OF TURBULENCE IN THE UPPER AIR FROM SOUNDING BALLOON ASCENTS
S. P. Venkiteshwaran Mar. 1964 25 p refs Presented at the 16th Ann. Gen. Meeting of the Aeron. Soc. of India, Bombay, 13–14 Mar. 1964
(TN-AE-23-64)

This paper describes the special features of the F-type radiosonde in distinguishing from the rotation of the fan whether the downward movement of the radiosonde balloon is due to a strong vertical downward current or due to the accumulation of snow. It shows how the rate of rotation of the fan can be used to identify regions of turbulence in the atmosphere. The observations of the turbulence with the F-type radiosonde are compared with the inferences drawn by turbasondes in the U.S.A. and the Dines meteorograph records in India. The regions where turbulence may be observed in India have been indicated. The existence of severe turbulence in the upper troposphere and in the stratosphere has been emphasized. Author

N64-29899 Air Weather Service, Scott AFB, Ill.
WEATHER MODIFICATION
Herbert S. Appleman Jul. 1964 23 p refs
(TR-177; AD-443779)

The ability to modify weather has become of singular importance in weather control and forecasting. Of primary interest is the ability to increase precipitation, to dissipate low stratus and fog, and to modify severe weather, particularly hail, lightning, and hurricanes. Cloud seeding for increasing rainfall consists of salt-particle seeding for warm clouds, and dry ice or silver iodide for supercooled clouds. Dry-ice seeding from aircraft has also proved effective in dissipating supercooled stratus and fog, although ice fogs cannot be treated by seeding techniques. No technique as yet has proved acceptable for modifying thunderstorms to suppress hail and lightning. A.W.

N64-29910 Air Force Cambridge Research Labs., Bedford, Mass. Upper Atmosphere Physics Lab.
FALLING SPHERE MEASUREMENTS OF ATMOSPHERIC DENSITY, TEMPERATURE, AND PRESSURE, UP TO 115 km
K. S. W. Champion and A. C. Faire Jul. 1964 35 p refs Presented at the 5th Intern. Space Sci. Symp. (COSPAR), Florence, Italy, May 1964 *Its* Environ. Res. Papers 34
(AFCRL-64-554; AD-605273)

Newly developed airborne instrumentation has made it possible to extend the measurements of atmospheric density, temperature, and pressure from the previous upper limit of 90 km to 115 km by means of the 7-in. rigid sphere method. A brief description of the instrumentation is given. Results of four rocket-borne experiments are presented and compared with the U.S. Standard Atmosphere, 1962, and a winter atmosphere for 30° latitude. Author

N64-30005 Massachusetts Inst. of Tech., Cambridge
MEASUREMENT OF DROP SIZE DISTRIBUTION AND LIQUID WATER CONTENT IN NATURAL CLOUDS Final Report
D. P. Keily 15 Feb. 1964 24 p refs
(Contract AF 19(628)-259)
(AFCRL-64-621; AD-604339)

Cloud drops striking a charged metal target are shown to produce an electric pulse whose shape indicates that the electric contact process is a succession of events probably, but not certainly, including corona, arcing, and conduction. Nevertheless, the pulse amplitude is closely proportional to the droplet surface area. Author

N64-30019 Aeronautical Research Council (Gt. Brit.)
POWER SPECTRA OF LOW LEVEL ATMOSPHERE TURBULENCE MEASURED FROM AN AIRCRAFT
A. Burns London, HMSO, 1964 62 p refs
(ARC-CP-733; replaces RAE-TN-STRUCT-329; ARC-24991)
HMSO: 12s

The note presents 30 power spectra of the vertical component of atmospheric turbulence and 12 power spectra of the horizontal component measured on a Canberra aircraft while flying at low altitude. The spectra relate to various types of terrain in U.K. and N. Africa. Comparative spectra are given for different heights above ground within the height band 200 to 1,000 ft. Some information is given on the associated meteorological conditions. The results are discussed briefly with a view to generalizing the basic shape of the spectra for the purpose of predicting fatigue loads. Comparison is made with proposed analytical expressions defining the basic shape. Author

N64-30060 Freie U., Berlin (W. Germany) Inst. für Meteorologie und Geophysik
DAILY AND MONTHLY NORTHERN HEMISPHERE 10-MILLIBAR SYNOPTIC WEATHER MAPS OF THE YEAR 1963. PART IV: OCTOBER–DECEMBER 4th Quarterly Technical Status Report
Barbara Kriester, Ingrid Reuter, Richard Scherhag, and Renate Stuhrmann Berlin, Verlag Dietrich Reimer, 1964 107 p *Its* Meteorol. Abhandl., v. XL, no. 4, 1964
(Contract DA-91-591-EUC-2857)
(AD-442690)

A summary of the upper stratospheric circulation during the last quarter of 1963 is given. Ten-millibar maps are given of the monthly mean for each month and also for the variation of the 10-millibar map from the preceding month. Daily 10-millibar maps are included for the quarter. D.E.W.

N64-30130 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ON STATIONARY METEOROLOGICAL MEASUREMENTS IN LOWER 300-METER LAYER OF THE ATMOSPHERE [IZUCHENIYE POGRANICHNOGO SLOYA ATMOSFERY S 300-METROVOY METEOROLOGICHESKOY BASHNI]
F. Ya. Klinov 6 Jul. 1964 63 p refs Transl. into ENGLISH from Inst. Prikl. Geofiz. (USSR), 1963
(FTD-MT-63-184; AD-603322)

The automatic geophysical observatory (AGO) was developed at the Soviet Institute of Applied Geophysics to provide stationary meteorological measurements in the lower 300-m layer of the atmosphere. A telemetering photopulse anemograph measures average wind speed on a high-altitude tower; instead of an individual unit for each sensing unit, the electronic decoding device has them combined into one panel. The automatic remote control "thermogradientograph" measures and registers temperature and its gradients; the sensing units

are copper resistance thermometers. Other measurements described as being made from the high-altitude tower include humidity, clouds, precipitation, and ice formation on construction. A.W.

N64-30139 Lockheed-California Co., Burbank
RESEARCH ON OCEANIC FORECASTING Technical Progress Report, 1 Mar. 1963–29 Feb. 1964
Apr. 1964 62 p refs
(Contract Nonr-3935(00))
(Rept.-17747; AD-603350)

Work was concentrated on the advection province in mid-latitude oceans away from vertical and lateral boundaries. Studies were made by analyzing synoptic data and individual profiles to determine optimum space and time coordinates to represent properly the three-dimensional pattern of oceanic properties. A theoretical dynamic model was developed by applying knowledge gained in meteorological study, since the basic principles covering motions in both fluid systems are essentially the same. An IBM-7094 computer program was written to evaluate and integrate this model. Test runs were made using various configurations of the pressure field to test the logic of the computer system, the behavior of the model, and the effects of fixed boundary values. The results of testing to date have indicated that the computational model is stable, and waves propagate through the field in a consistent manner. However, boundary effects do enter into the computations, and further work is necessary to suppress or eliminate these effects. The waves propagated through the field appear to support the theory that divergent inertial waves are more evident than Rossby waves. R.L.K.

22 NAVIGATION AND GUIDANCE

Includes autopilots; star tracking; inertial platforms; and air traffic control. *For related information see*: 06 Auxiliary Systems; 08 Communications; 09 Electronics; 10 Facilities, Research and Support; 15 Instrumentation and Photography; 20 Mathematics; and 29 Space Sciences.

N64-29612 Air Force Systems Command, Wright-Patterson AFB, Ohio Research and Technology Div.
X-20A GUIDANCE PHILOSOPHY AND MECHANIZATION Technical Documentary Report, Nov. 1960–Dec. 1963
May 1964 42 p refs
(SEG-TDR-64-5; AD-602628) OTS: $2.00

The general X-20A guidance requirements, the philosophy of operation in the primary and secondary modes, and a general description of the physical hardware that meets the established navigation and guidance requirements are presented. Status of the various guidance elements and some unique integration problems and solutions are also discussed. It is shown that the requirements for the once-around X-20A mission can be met with mature state-of-the-art sensors, techniques, and hardware elements. Author

N64-29884 Autonetics, Anaheim, Calif.
A DEVICE FOR REMOTE MONITORING OF HELMET POSITION
C. P. Greening, J. S. Sweeney, and H. L. Snyder 27 Jul. 1964 16 p Presented at 5th Natl. Symp. on Human Factors in Electron., 5–6 May 1964

This paper describes a device that senses the direction of a pilot's line-of-sight remotely, by monitoring his helmet position. A schematic description of the device, and data on its performance are presented. Several possible applications are noted. Author

N64-30192* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SPACE VEHICLE GUIDANCE—A BOUNDARY VALVE FORMULATION. PART II: BOUNDARY CONDITIONS WITH PARAMETERS
Robert Silber 28 Jul. 1964 10 p
(NASA-TM-X-53100) OTS: $1.10 ph

Previously, the control laws for space vehicle guidance were formulated as a set of functions implicitly defined by a set of boundary conditions. In this report the domain of the control laws is augmented to contain mission parameters. In this way, the control laws are defined for a family of missions rather than for a single mission. Author

23 PHYSICS, GENERAL

Includes acoustics; cyrogenics; and optics. *For astrophysics see*: 05 Astronomy and Astrophysics. *For related information see*: 12 Geophysics; 29 Space Sciences; 24 Physics, Plasma; and 25 Physics, Solid-State.

N64-29052 Israel Program for Scientific Translations, Ltd., Jerusalem
ADVANCES IN PHYSICAL SCIENCES, VOLUME 65, NOS. 1–4, MAY–AUGUST
D. Bergman and I. Meroz eds. 1964 562 p refs Transl. into ENGLISH of USP. Fiz. Nauk (Moscow), v. 65, no. 1–4, May–Aug. 1958 Sponsored by AEC and NSF
(AEC-TR-5332; IPST-996) OTS: $5.75

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N64-29053 Israel Program for Scientific Translations, Ltd., Jerusalem

OPTICAL TRANSITION PROBABILITIES FOR ATOMS AND DIATOMIC MOLECULES [VEROYATNOSTI OPTICHESKIKH PEREKHODOV DLYA ATOMOV I DVUKHATOMNYKH MOLEKUL]

V. N. Kolesnikov and L. V. Leskov *In its* Advan. in Phys. Sci., v. 65, nos. 1–4, May–Aug. 1958 1964 p 1–44 refs (See N64-29052 21-23) OTS: $5.75

Existing methods of calculation of the probabilities of electronic and vibrational transitions in diatomic molecules are reviewed. The review attempts to give a bibliography, which cites both theoretical and experimental literature published after 1930 on the determination of the probabilities of optical transitions in atoms, and of electronic and vibrational transitions in diatomic molecules. Tables are included that show types of transitions studied for various elements, references where studies on these transitions can be found, and methods used in studying the transitions. P.V.E.

N64-29055 Israel Program for Scientific Translations, Ltd., Jerusalem

SPIN ECHOES AND THEIR APPLICATION [YAVLENIE SPINOVYKH EKHO I EGO PRIMENENIE]

N. M. Pomerantsev *In its* Advan. in Phys. Sci., v. 65, nos. 1–4, May–Aug. 1958 1964 p 94–116 refs (See N64-29052 21-23) OTS: $5.75

Papers dealing with the physical aspects of spin echoes and their applications are reviewed. Included in the review are the following topics: (1) the physical principle of the spin echo phenomenon; (2) methods of spin echo observations; (3) study of relaxation processes using spin echoes; (4) application of spin echoes to the study of the magnetic microstructure of molecules; and (5) application of spin echoes to delay lines and storage units. P.V.E.

N64-29056 Israel Program for Scientific Translations, Ltd., Jerusalem

SEVERAL POSSIBILITIES OF USING POLARIZED THERMAL NEUTRONS IN VIEW OF PARITY NONCONSERVATION DURING β-DECAY [NEKOTORYE VOZMOZHNOSTI ISPOL'ZOVANIYA POLYARIZOVANNYKH TEPLOVYKH NEITRONOV, SVYAZANNYE S NESOKHRANENIEM CHETNOSTI PRI β-RASPADE]

F. L. Shapiro *In its* Advan. in Phys. Sci., v. 65, nos. 1–4, May–Aug. 1958 1964 p 117–124 refs (See N64-29052 21-23) OTS: $5.75

The use of polarized thermal neutrons to determine the spin level of the compound nucleus, obtained when polarized neutrons are captured by polarized nuclei, is discussed. In order to measure the spin of such a compound nucleus, it is sufficient to measure its polarization or that of the final stable nucleus. In most cases, the final nucleus is β-active; inasmuch as it is polarized, its β-radiation is anisotropic. The degree of angular anisotropy is proportional to the polarization. Polarization measurements may also serve for the determination of the magnetic moment of short-lived nuclei formed upon capture of neutrons. P.V.E.

N64-29057 Israel Program for Scientific Translations, Ltd., Jerusalem

XI CONFERENCE ON SPECTROSCOPY [XI SOVESHGHANIE PO SPEKTROSCOPII]

H. Kaliteevskii, B. Neporent, and P. Feofilov *In its* Advan. in Phys. Sci., v. 65, nos. 1–4, May–Aug. 1958 1964 p 125–146 (See N64-29052 21-23) OTS: $5.75

The papers presented at the conference were divided into the following major topics and subtopics: (1) atomic spectroscopy—calculation of atomic energy levels and determination of atomic constants, the interaction of the nucleus with the electronic shells, the spectroscopy of gas discharges, and spectroscopic methods of temperature determination; (2) molecular spectroscopy—electronic, oscillatory, and rotational; and (3) spectroscopy of solids—spectroscopy of molecular crystals, the problem of the spectroscopic discovery of the excitation, spectroscopy of ionic crystals containing activating centers, and spectroscopy of color centers in ionic crystals. P.V.E.

N64-29059 Israel Program For Scientific Translations, Ltd., Jerusalem

FERROMAGNETICS AND ANTIFERROMAGNETICS NEAR THE CURIE POINT [FERROMAGNETIKI I ANTIFERROMAGNETIKIS VBLIZI TOCHKI KYURI]

K. P. Belov *In its* Advan. in Phys. Sci., v. 65, nos. 1–4, May–Aug. 1958 1964 p 164–216 refs (See N64-29052 21-23)

Experimental material published on phenomena occurring in materials (metals, alloys, ferrites, sulfides, and other ferromagnetic and antiferromagnetic materials) near the temperature of magnetic transition is systematized. Emphasis is placed on experimental facts obtained and on the essential features of the thermodynamic methods used in the various experimentations. P.V.E.

N64-29060 Israel Program for Scientific Translations, Ltd., Jerusalem

INTERNATIONAL CONGRESS ON ELEMENTARY PARTICLES IN ITALY [MEZHDUNARODNYI KONGRESS PO ELEMENTARNYM CHASTITSAM V ITALII]

D. Ivanenko *In its* Advan. in Phys. Sci., V. 65, nos. 1–4, May–Aug. 1958 1964 p 218–242 ref (See N64-29052 21-23) OTS: $5.75

Activities at the international congress on elementary particles (1957) are reported. The congress dealt mainly with parity nonconservation in weak interactions. P.V.E.

N64-29061 Israel Program for Scientific Translations, Ltd., Jerusalem

NEGATIVE IONS [OTRITSATEL'NYE IONY]

N. S. Buchel'nikova *In its* Advan. in Phys. Sci., v. 65, nos. 1–4, May–Aug. 1958 1964 p 243–279 refs (See N64-29052 21-23) OTS: $5.75

The following topics are discussed with respect to the formation of negative ions: (1) measurement and calculation of the electron affinity of atoms, molecules, and radicals; (2) formation processes (of negative ions)—radiative capture, two-electron capture by positive ions, electron capture by fast atoms, surface ionization, negative ions produced by positive ions striking a surface, and negative ion sources; (3) determination of attachment cross sections of slow electrons—microwave method, and method of single encounters; and (4) dissociation processes (of negative ions)—photostripping, stripping in electron collisions, collision of negative ions with atoms and molecules, and interaction of negative ions with a surface. P.V.E.

N64-29063 Israel Program for Scientific Translations, Ltd., Jerusalem

USE OF ROTATIONAL RAMAN SPECTRA FOR THE DETERMINATION OF MOLECULAR STRUCTURAL PARAMETERS [PRIMENENIE VRASHCHATEL'NYKH SPEKTROV KOMBINATSIONNOGO RASSEYANIYA DLYA OPREDELENIYA STRUKTURNYKH PARAMETROV MOLEKUL]

M. M. Sushchinskii *In its* Advan. in Phys. Sci., v. 65, nos. 1–4, May–Aug. 1958 1964 p 302–311 refs (See N64-29052 21-23) OTS: $5.75

A survey of recent papers is presented, dealing with the use of rotational Raman spectra to obtain information on the structure of molecules. By using rotational Raman spectra the moments of inertia of molecules can be determined; from the moments of inertia the interatomic distances and the valence bond angles can be found. Various experimental methods are discussed. In the analysis of rotational Raman spectra (considering the rotation of the molecules as a rigid body) two types of molecules are considered: linear molecules, in which one of the three principal moments of inertia is equal to zero, and molecules of the symmetric top type, in which two of the principal moments of inertia are equal. P.V.E.

N64-29064 Israel Program for Scientific Translations, Ltd., Jerusalem

NEW MEASUREMENTS OF ATOMIC MASSES [NOVYE IZMERENIYA MASS ATOMOV]

V. A. Kravtsov *In its* Advan. in Phys. Sci., v. 65, Nos. 1–4, May–Aug. 1958 1964 p 312–346 refs (See N64-29052 21-23) OTS: $5.75

Atomic mass values published from 1955 to 1958 and the contradictions therein are considered and evaluated. Some high-accuracy mass spectroscopic measurements published from 1955 to 1957, which make it possible to eliminate some of the errors and discrepancies in the previous measurements, are described. Methods for finding errors in previous measurements and for obtaining new data of higher accuracy are given. Examples of applying the new values of atomic masses to the solution of some problems in nuclear physics are given. Tables of atomic masses and nuclear binding energies obtained in recent years are also given. Author

N64-29065 Israel Program for Scientific Translations, Ltd., Jerusalem

METHODS FOR THE FILING OF MOLECULAR SPECTRA [SISTEMY DOKUMENTATSII MOLEKULYARNYKH SPEKTROV]

V. V. Nalimov and B. S. Neporent *In its* Advan. in Phys. Sci., v. 65, nos. 1–4, May–Aug. 1958 1964 p 347–367 refs (See N64-29052 21-23)

Methods of filing the infrared absorption spectra of molecular compounds on cards are discussed. Two basic methods are employed in spectroscopic filing: (1) multichannel punched cards and (2) cards punched along the edges. The cards are filled out both from published data and from reports received directly from the laboratories doing the investigations. Filing methods using both types of cards are discussed. P.V.E.

N64-29066 Israel Program for Scientific Translations, Ltd., Jerusalem

A NEW HIGH PRECISION MASS-SPECTROMETER [NOVYI MASS-SPEKTROMETR VYSOKOI TOCHNOSTI]

V. A. Kravtsov *In its* Advan. in Phys. Sci., v. 65, nos. 1–4, May–Aug. 1958 1964 p 368–370 refs (See N64-29052 21-23) OTS: $5.75

A description is presented of a highly accurate mass spectrometer in use at the University of Minnesota. The spectrometer employs double focusing and a new (1956) method of recording ions. P.V.E.

N64-29067 Israel Program for Scientific Translations, Ltd., Jerusalem

DIRECT DETERMINATION OF THE SPECTRUM OF ELEMENTARY EXCITATIONS IN LIQUID HELIUM II [PRYAMOE OPREDELENIE SPEKTRA ELEMENTARNYKH VOZBUZHDENII V ZHIDKOM GELII II]

R. Chentsov *In its* Advan. in Phys. Sci., v. 65, nos. 1–4, May–Aug. 1958 1964 p 371–373 refs (See N64-29052 21-23) OTS: $5.75

Two methods used for the determination of the spectrum of elementary excitations in liquid helium II are discussed. The first is based on the scattering of slow monoenergetic neutrons by liquid helium and the second involves the scattering by liquid helium of neutrons that have a continuous energy distribution. P.V.E.

N64-29068 Israel Program for Scientific Translations, Ltd., Jerusalem

MODERN THEORY OF SUPERCONDUCTIVITY [SOVREMENNAYA TEORIYA SVERKHPROVODIMOSTI]

A. Abrikosov and I. Khalatnikov *In its* Advan. in Phys. Sci., V. 65, Nos. 1–4, May–Aug. 1958 1964 p 377–415 refs (See N64-29052 21-23) OTS: $5.75

An outline of the modern theory of superconductivity is presented. Some results of investigations of the behavior of superconductors in a high-frequency electromagnetic field are also presented. Subjects discussed in detail include these: (1) the Cooper phenomenon; (2) the ground state of a superconductor; (3) the role of coulomb interaction of electrons; (4)

thermodynamics of superconductors; (5) equations of electrodynamics for superconductors; (6) observations on the properties of superconductors of finite size; and (7) thermal conductivity of superconductors. P.V.E.

N64-29069 Israel Program for Scientific Translations, Ltd., Jerusalem
DIFFRACTION PHENOMENA IN COLLISIONS OF FAST PARTICLES WITH NUCLEI [DIFRAKTSIONNYE YAVLENIYA PRI STOLKNOVENIYAKH BYSTRYKH CHASTITS S YADRAMI]
A. I. Akhiezer and I. Ya. Pomeranchuk *In its* Advan. in Phys. Sci., v. 65, nos. 1–4, May–Aug. 1958 1964 p 416–452 refs (See N64-29052 21-23) OTS: $5.75

The results of basing a semiphenomenological theory of high-energy diffraction on the generalized Huygens principle are discussed. The theory is used to investigate the following: (1) elastic diffraction scattering; (2) effect of semitransparency of the nucleus on diffraction scattering; (3) effects of the nuclear coulomb field; (4) diffraction emission of photons by pions; (5) photon emission involving pion absorption by a nucleus or nucleon; (6) diffraction pion pair production by a photon; (7) diffraction emission of photons by particles of spin1/2—diffraction nucleon pair production by photons; (8) capture emission of photons by particles of spin 1/2; and (9) diffraction phenomena in the scattering of fast deutrons on nuclei. P.V.E.

N64-29071 Israel Program for Scientific Translations, Ltd., Jerusalem
ELECTRON WAVE INTERFERENCE [INTERFERENTSIYA ELEKTRONNYKH VOLN]
V. I. Milyutin *In its*Advan. in Phys. Sco, v. 65, nos. 1–4, May–Aug. 1958 1964 p 486–509 refs (See N64-29052 21-23) OTS: $5.75

Experiments on electron-wave interference, schemes for the first electron interferometers, and some of their applications are briefly described. The results of experiments using electron interference have indicated the following conclusions: (1) The possibility of performing electron-wave interference experiments under various conditions has been shown. (2) Electron interference experiments use light-optics analogy. The first attempts at conducting experiments similar to light optics were successful. (3) The problem of electron-wave coherence has not been sufficiently studied. (4) The experiments on electron interference showed the possibility of applying the phenomenon of electron interference to practical applications. P.V.E.

N64-29239 Nihon U., Tokyo (Japan) Coll. of Science and Engineering
MASS FORMULA FOR BOSONS AND COMPOSITE MODEL
Shin Ishida [1964] 7 p refs
(NUP-64-12)

This report deals with the mass difference among boson multiplets and shows, by simple treatment, that this difference is explained well by the assumption, along the line of thought of the Sakata model, that the symmetry-breaking Hamiltonian is only due to the existence of the mass difference δM between the ur-nucleon and the ur-Λ-hyperon. The following mass formulas are obtained: $m_\phi - m_\rho = 2(m_{K^*} - m_\rho)$, and $m_\omega = m_\rho$. I.v.L.

N64-29240 Indiana U., Bloomington
NUCLEAR SPECTROSCOPY RESEARCH Final Report, 1 Apr. 1955–31 Mar. 1964
[1964] 12 p refs
(Contract Nonr-1705(01))
(AD-601884)

The long-term objective of this program is to obtain information about the structure of the nuclei of atoms and about the nature of the basic nuclear forces. Some investigations have involved these efforts: (1) the determination of decay schemes and energy-level assignments by the measurement of beta- and gamma-ray energies, beta–gamma coincidence measurements, gamma-gamma coincidence measurements, and gamma-gamma angular correlation measurements; (2) studies of the detailed shapes of beta spectra in both "allowed" and "forbidden" transitions, wherein measurements were obtained that revealed subtilties and evidence for the existence of higher-order effects, which had been neglected in the usual approximate application of the theory; and (3) beta–gamma angular correlation measurements and the evaluation of nuclear matrix elements. By combining the information derived from beta–gamma angular correlation determinations with the beta-spectrum-shape measurements made on the same element, it is possible to evaluate, at least, the ratio of matrix elements that govern the transition. I.v.L.

N64-29249 Johns Hopkins U., Baltimore, Md.
ANALOG COMPUTER RESEARCH INTO THE ENERGY-EXCHANGE BETWEEN GASES AND SOLIDS
Milton Rogers May 1964 224 p refs
(Contract AF 49(638)-496)
(AFOSR-64-1001; AD-605401)

Interdisciplinary research on the interaction of gases and solids is discussed and includes an assessment of the isomorphism (or lack of isomorphism) of mechanical and electronic analogies of the interactions. A comparison is made between various models of the interaction that have appeared in the literature. The circuitry and techniques used to investigate the problem of energy exchange between gases and solids are described. Bounds on the applicability and interpretation of data obtained solely from computational experiments, whether performed with an analog or a digital computer, are delineated in some detail. The data obtained in a series of analog computer experiments in gas surface interactions are presented and interpreted, using several variations of a very simple model of the interaction potential, the lattice, and the physical state of the solid, particularly temperature. Author

N64-29292 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
NEWS OF THE ACADEMY OF SCIENCES OF THE USSR. TECHNOLOGY SECTION: MECHANICS AND MACHINE BUILDING Selected Articles
16 Jun. 1964 36 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. I Mashinostr. (Moscow), no. 1, 1963 p 33–46
(FTD-TT-64-413/1+2+4; AD-602310)

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2. DETERMINATIONS OF CONSTRAINTS IN A SYSTEM OF RIGID BODIES A. I. Lur'ye p 17–26 (See N64-29294 21-23)
3. APPROXIMATE DESIGN OF PROTECTIVE METEOR SHIELDS L. S. Bezgin and M. I. Ivashchenko p 27–33 refs (See N64-29295 21-34)

N64-29293 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

THE UNPERTURBABILITY OF A SPHERICAL PENDULUM OF VARIABLE LENGTH WITH MOTION OF THE FULCRUM IN A CENTRAL GRAVITATIONAL FIELD

M. Z. Litvin *In its* News of the Acad. of Sci. of the USSR, Technol. Sect.: Mech. and Machine Bldg. 16 Jun. 1964 p 1–16 refs (See N64-29292 21-23)

A solution is offered to the problem of assuring nonperturbability of a pendulum as a model of a corresponding gyroscopic system existing when the length of the pendulum is less than the distance from the fulcrum to the center of the field. Such a solution is obtained with a pendulum of variable length based on the fact that, for a definite law of variation of the pendulum length, the force of inertia of the pendulum, stipulated by its rotational acceleration, counteracts the perturbations of the pendulum. A.W.

N64-29294 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

DETERMINATIONS OF CONSTRAINTS IN A SYSTEM OF RIGID BODIES

A. I. Lur'ye *In its* News of the Acad. of Sci. of the USSR, Technol. Sect.: Mech. and Machine Bldg. 16 Jun. 1964 p 17–26 (See N64-29292 21-23)

A system, S, of rigid bodies is considered, the configuration of which is given by generalized coordinates $q_1, \ldots, q_n$. One particular case of rheonomic constraints is also considered. Several equations are given and analyzed. A.W.

N64-29325 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

NEWTONIAN EQUATIONS OF MOTION AND HARMONIC CONDITIONS IN THE THEORY OF GRAVITATION

Cz. Jankiewicz 15 Aug. 1964 16 p refs Transl. into ENGLISH from Zh. Eksperim. Teor. Fiz. (Moscow), v. 44, no. 2, Feb. 1963 p 649–656

(FTD-TT-63-593/1+2+4; AD-420865)

The relation between Newtonian equations of motion and harmonic conditions in Einstein's theory of gravitation is examined. Assuming that a metric tensor can be represented in the form of a power series, it is proved that in order to obtain Newtonian equations of motion, it is necessary to use harmonic coordinate conditions of zero order. It is also proved that in Infeld's method for deriving Newtonian equations of motion from the equations for the gravitational field, coordinate conditions are used, which not only contain harmonic conditions of zero order but also stronger ones. Author

N64-29329 Boeing Co., Seattle, Wash. Aero-Space Div.

COMPUTER CODES FOR SPACE RADIATION ENVIRONMENT AND SHIELDING, VOLUME I

J. A. Barton, B. W. Mar, G. L. Keister et al Kirtland AFB, N. Mex., AF Weapons Lab., Aug. 1964 199 p refs

(Contract AF 29(601)-6061)

(WL-TDR-64-71, Vol. I; AD-444602)

The radiation environment, including spectral, angular, and temporal dependence was represented mathematically, and calculation of the flux and flux rate of each particle type was coded. Specifically, codes were devised to determine the spacecraft trajectory; to convert the trajectory in geographic coordinates to magnetic coordinates B, L, and t and to equivalent magnetic dipole coordinates R, λ, and t; to calculate the unit-flux dose or total dose of penetrating and secondary radiation at a dose point within the spacecraft; and to integrate the various subroutines and instruct a plotter to plot program output. Author

N64-29341* National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt, Md.

2s AND 2p ELECTRON IMPACT EXCITATION IN ATOMIC HYDROGEN

Kazem Omidvar Repr. from the Phys. Review, v. 133, no. 4A 17 Feb. 1964 p A970–A985 refs

(NASA-RP-305)

A numerical calculation has been carried out to evaluate the 3 × 3 cross-section matrix involved in the electron impact excitation of the ground state of H atom to the 2*s* and 2*p* levels. The method of solution is that of atomic eigenstates expansion. In this paper, instead of the iterative technique, the definite integral terms in the coupled radial differential equations are eliminated through some linear transformation of the radial functions, thus avoiding iteration of these equations. The accuracy of the numerical integration is tested by satisfying the equation of reciprocity and the equation of continuity of currents with an error-to-value ratio less than 1 per 1,000 on the average; and the maximum of this ratio, except for a few cases, has been kept below 5%. The results are in agreement with the results of an iterative technique. Author

N64-29347 Army Missile Command, Huntsville, Ala. Physical Sciences Lab.

ENERGY MINIMUM PRINCIPLE FOR HARTREE-FOCK CALCULATIONS OF CERTAIN EXCITED ATOMIC STATES

J. F. Perkins 13 Jul. 1964 26 p refs

(RR-TR-64-9; AD-445018)

An energy minimum principle for Hartree–Fock calculations of atomic states not the lowest of a given symmetry is shown to hold under conditions that are satisfied for a large number of optical states, without the necessity of constraining the trial function to be orthogonal to wave functions of lower states of the same symmetry. The principle follows from application of a theorem by MacDonald and by Hylleraas and Undheim to an expansion-type Hartree–Fock procedure in which the radial function of the excited electron is expanded in a fixed basis set while all other orbitals are assumed fixed. Useful applicability of the principle requires a suitable one-to-one correspondence between the lower-energy solutions of the variational equation for a single series electron and the lower-lying states of the same symmetry. Author

N64-29366* Boeing Co., Seattle, Wash. Aero-Space Div.

COMPUTER CODES FOR THE EVALUATION OF SPACE RADIATION HAZARDS. VOL. 4. SPACE RADIATION DOSES FROM ELECTRON BREMSSTRAHLUNG RADIATION

Raymond P. Moshofsky [1964] 48 p refs

(Contract NAS9-1393)

(NASA-CR-58295; D2-90418-4) OTS: $4.60 ph

This IBM 7090 FORTRAN program calculates the bremsstrahlung radiation dose received through several slabs of shield material; only electron-produced bremsstrahlung are considered. Required inputs to this program are the incident electron spectrum; photon attenuation coefficients; buildup coefficients; shield materials and thicknesses, and solid angles; and flux-to-dose conversion factors. The calculated dose is called the electron bremsstrahlung radiation dose and is computed in an equation. The program may also be used to estimate the bremsstrahlung radiation dose received by men or equipment inside a vehicle situated in a region of electron radiation. To perform these calculations, the program requires a resolution of all material in the vehicle into an equivalent polyhedral shell. Author

N64-29398 Colorado State U., Fort Collins
STUDIES, RESEARCH AND INVESTIGATIONS OF THE OPTICAL PROPERTIES OF THIN FILMS OF METALS, SEMICONDUCTORS AND DIELECTRICS Semi-Annual Report, Aug. 16, 1963–Feb. 15, 1964
Lawrence N. Hadley [1964] 59 p refs
(Contract DA-44-009-ENG-3828)
(SAR-9; AD-445110)

An investigation of electromagnetic levitation with simultaneous induction heating as a possible method of making high-purity evaporations in vacuum is discussed. A review of the literature dealing with electromagnetic levitation is presented, and a general outline of the argument used to derive the exact equations for the levitation force on a sphere, and for the power absorbed by the sphere as it is suspended on the axis of two circular coaxial current rings, is given. P.V.E.

N64-29424 Los Alamos Scientific Lab., N. Mex.
AUTOMATIC STARTUP FOR NUCLEAR REACTORS
G. L. Hohmann and B. G. Strait (Westinghouse Elect. Corp.,) 27 Aug. 1964 47 p refs
(Contract W-7405-ENG-36)
(LAMS-3111) OTS: $1.00

The startup was achieved automatically by programing the control rods rapidly to the approximate delayed-critical position and then continuing to move them slowly until the power reached a preselected level. At this time the power control system was switched into operation. Thus, the reactor was automatically brought from a source power level (about $4 subcritical) through approximately 6 decades of power to a level slightly above the low end of the operating range of the logarithmic neutron detector used for full-power operation. At this power level the power control system was closed in a stable manner, and no significant heat generation was present. Therefore, only one set of neutron detectors was required for reactor operation. Author

N64-29477 Naval Ordnance Lab., Corona, Calif.
PROCEEDINGS, FAR INFRARED PHYSICS SYMPOSIUM, JANUARY 20–21, 1964, RIVERSIDE, CALIFORNIA
[1964] 128 p refs
(AD-440195)

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3. HIGH RESOLUTION FOURIER TRANSFORM INTERFEROMETRY IN THE FAR-INFRARED (Bell Telephone Labs.) p 23–59 refs (See N64-29480 21-23)

4. FAR INFRARED SPECTROSCOPY OF SOLIDS C. H. Perry (MIT) p 61–75 refs (See N64-29481 21-23)

5. FAR INFRARED MAGNETO-OPTICAL STUDIES OF SEMICONDUCTORS E. D. Palik (Naval Res. Lab.) p 77–103 refs (See N64-29482 21-23)

6. SIZE EFFECTS IN INFRARED LATTICE ABSORPTION M. Hass (Naval Res. Lab.) p 105–115 refs (See N64-29483 21-23)

N64-29478 Ohio State U., Columbus Lab. of Molecular Spectroscopy and Infrared Studies
SOME EXPERIENCES WITH INTERFEROMETRIC TECHNIQUES IN THE FAR INFRARED
Ely E. Bell *In* Naval Ord. Lab., Corona, Calif. Proc., Far Infrared Phys. Symp., Jan. 20–21, 1964, Riverside, Calif. [1964] p 1–13 refs (See N64-29477 21-23)

Two instruments used in studies involving the far infrared are discussed—a periodic operating lamellar grating and a Michelson interferometer. P.V.E.

N64-29479 Massachusetts Inst. of Tech., Cambridge
HIGH MAGNETIC FIELD FAR INFRARED RADIATION SOURCES
Benjamin Lax and Donald T. Stevenson *In* Naval Ord. Lab., Corona, Calif. Proc., Far Infrared Phys. Symp., Jan. 20–21, 1964, Riverside, Calif. [1964] p 15–22 refs Sponsored by AFOSR (See N64-29477 21-23)

Three different methods for using high magnetic fields in the generation of radiation in the far infrared and submillmeter region are discussed. The first is a synchrotron radiation source of a high-energy electron beam in magnetic fields of the order of 100,000 gauss. The second is a radiation source involving an ionized gas of plasma that emits energy at the cyclotron frequency and its harmonics. The third involves cyclotron resonance radiation from solids that are excited by a primary laser source. P.V.E.

N64-29480 Bell Telephone Labs., Inc., Murray Hill, N.J.
HIGH RESOLUTION FOURIER TRANSFORM INTERFEROMETRY IN THE FAR-INFRARED
P. L. Richards *In* Naval Ord. Lab., Corona, Calif. Proc., Far Infrared Phys. Symp., Jan. 20–21, 1964, Riverside, Calif. [1964] p 23–59 refs (See N64-29477 21-23)

The construction and performance of three far-infrared spectrometers are described. These are a large-aperture diffraction-grating monochromator using six 28- by 35-cm interchangeable echelette gratings to span the frequency region from 10 to 150 cm^{-1}, a set of 30-cm^2 lamellar grating plates, which can be inserted into the grating monochromator converting it into a lamellar grating interferometer, and an 18-cm Michelson interferometer. The two interferometers are used with an automatic digital data recording system, which records the interferograms on punched cards so that the spectra can be obtained by numerical Fourier transformation on a digital computer. All three instruments have been operated with the same detector and the same source, thus providing, for the first time, a controlled test of the relative merits of these three types of spectrometers. As expected theoretically, the two interferometers performed similarly except for differences due to beam splitter efficiency and mechanical accuracy. Author

N64-29481 Massachusetts Inst. of Tech., Cambridge
FAR INFRARED SPECTROSCOPY OF SOLIDS
Clive H. Perry *In* Naval Ord. Lab., Corona, Calif. Proc., Far Infrared Phys. Symp., Jan. 20–21, 1964, Riverside, Calif. [1964] p 61–75 refs (See N64-29477 21-23)
(NSF G-19637)

A spectrometer for conducting studies in the far infrared is discussed. Also discussed are two solid-state studies in the far infrared—the far infrared spectra of some peroviskite materials, and the infrared absorption spectra of crystalline K_2PtCl_4. P.V.E.

N64-29482 Naval Research Lab., Washington, D.C.
FAR INFRARED MAGNETO-OPTICAL STUDIES OF SEMICONDUCTORS
E. D. Palik *In* Naval Ord. Lab., Corona, Calif. Proc., Far Infrared Phys. Symp., Jan. 20–21, 1964, Riverside, Calif. [1964] p 77–103 refs (See N64-29477 21-23)

Magneto-optical experiments for studying the energy-band structure of semiconductors are discussed. A theoretical discussion of free carrier effects (Drude theory and quantum band theory) is also presented. Experimental results discussed are

concerned with the following: (1) cyclotron resonance; (2) Faraday rotation; (3) Voigt effect; (4) magnetoplasma effects; and (5) interference fringe effects. Also included is a discussion of impurity effects. P.V.E.

N64-29483 Naval Research Lab., Washington, D.C.
SIZE EFFECTS IN INFRARED LATTICE ABSORPTION
Marvin Hass *In* Naval Ord. Lab., Corona, Calif. Proc., Far Infrared Phys. Symp., Jan. 20–21, 1964, Riverside, Calif. [1964] p 105–115 refs (See N64-29477 21-23)

Theoretical indications suggesting that the lattice vibration spectrum and resulting infrared absorption depend upon the size and shape of the crystals are discussed. Experiments involving the fine powers and evaporated films are outlined. It is concluded that size effects have been established in the infrared absorption spectrum and that these are consistent with current ideas regarding the lattice vibrations of finite crystals. P.V.E.

N64-29500 India. Dept. of Atomic Energy, Bombay. Nuclear Physics Div.
VAN DE GRAAFF LABORATORY Progress Report, Apr. 1962–Dec. 1963
A. S. Divatia, comp. 1964 27 p
(AEET/NP/8)

Investigations involving the Van de Graaff accelerator, including the following, are summarized: (1) mechanism of the $^{7}Li(p, \alpha)^{4}He$ reactions; (2) the $^{10}B(\alpha, p)^{13}C$ reactions; (3) energy levels of ^{27}Al from a study of proton inelastic scattering; (4) polarization of protons in $^{12}C(p,p)^{12}C$ scattering; (5) angular distribution of $^{12}F(n,\alpha)^{16}N$ reactions; and (6) angular correlation studies in $^{37}Cl(p, n' \gamma)^{37}$ A reactions. P.V.E.

N64-29527 Carnegie Inst. of Tech., Pittsburgh, Pa.
LITERATURE SURVEY OF NUCLEON 2 NUCLEON REACTION CROSS SECTIONS AT ENERGIES ABOVE 100 MEV
Albert A. Caretto, Jr. Washington, AEC, Jul. 1964 88 p refs
(Contract AT(30-1)-2897)
(NYO-10693) Available from Clearinghouse for Fed. Sci. and Tech. Inform., Springfield, Va. $2.00

The primary sources of literature that were searched for pertinent references were: Physics Abstracts, Nuclear Science Abstracts, Chemical Abstracts, Physical Review, Nuclear Physics, Proceedings of the Physical Society, Compte Rendu, and Soviet Physics: When appropriate, all experimental cross sections listed have been normalized to the $Al^{27}(p,3pn)Na^{24}$ and $C^{12}(p,pn)C^{11}$ monitor cross sections. Each entry listed in the tables has been given a rating as to the reliability of the data in accordance with the criteria used in making these judgments. Author

N64-29543 California U., La Jolla
A CALCULATION OF THE PHONON FREQUENCIES IN SODIUM
L. J. Sham Apr. 1964 31 p refs
(Contract Nonr-2216-(11))
(TR-18; AD-601879)

The phonon spectrum of sodium is calculated in the harmonic approximation. The effective interaction between the ions is separated into direct two-body forces between bare ions and effective attraction due to the presence of conduction electrons. Careful treatment of the two-phonon processes includes the calculation of the electron–phonon scattering based on the pseudopotential method and the screening effects due to the interaction between electrons by the Hartree–Fock approximation with a screened exchange potential. Comparison of the results for sodium with neutron diffraction measurements and a previous calculation by Toya shows good agreement on the whole. Author

N64-29570* Stanford U., Calif.
ON THE CAPTURE, STABILITY, AND PASSIVE DAMPING OF ARTIFICIAL SATELLITES
Ralph Pringle, Jr. Apr. 1964 190 p refs
(Grant NsG-133-61)
(NASA-CR-58291; SUDAER-181) OTS: $13.00 ph

This dissertation treats analytically the dynamics of passively damped, gravity stabilized artificial satellites. Methods are devised to analyze the following phases of satellite evolution: (1) tumbling motions after launch, (2) capture into a bounded libration motion, (3) stability of equilibrium solutions, and (4) damping of the libration motion. These methods are applied to three typical satellite designs of current importance: Vertistat, Beam, and TRAAC. Author

N64-29584 Naval Ordnance Lab., White Oak, Md.
EXCITED LEVELS OF N^{15} AND O^{15}
A. E. Evans 9 Mar. 1964 12 p refs
(NOLTR-64-46; AD-601965) OTS: $0.50

The theory of 1p-shell energy levels is reviewed, with particular emphasis on calculations for N^{15} and O^{15}. The effect of the relative strengths of space and spin-exchange forces and the spin-orbit force are discussed. Experimental data on the level structures of N^{15} and O^{15} are compared with each other and with theory. Particular emphasis is placed upon spin and parity assignments for the first eleven levels in O^{15}. Author

N64-29592 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
SCATTERING OF NEUTRONS ON MOLECULAR SYSTEMS
Jerzy A. Janik 23 Jul. 1964 33 p refs Transl. into ENGLISH from Postepy Fiz. (Poland), v. 14, no. 2, 1963 p 167–190
(FTD-TT-64-196/1+2; AD-446410)

Neutron scattering on gas, liquid, and solid molecular systems is reviewed. The historical development of the neutron scattering theory is presented, and the basic experimental technique is discussed. The application of neutron methods to investigation of hydrogen-containing gas molecules cannot be used to implement molecular structural investigations, but does serve as a tool for investigating the adequacy of existing theories. The Krieger–Nelkin theory is examined in this way, and several deficiencies are established. Information on molecular systems in liquids that has been obtained using both total cross section and the effective cross-section measurements of the energy distribution of scattered neutrons is reviewed. Finally, the use of neutron scattering methods to derive information about the degrees of freedom of molecular crystal groups is considered. M.P.G.

N64-29610 Boeing Scientific Research Labs., Seattle, Wash.
PATTERN RECOGNITION BY THE METHOD OF ISOCLINES: I. A MATHEMATICAL MODEL FOR THE VISUAL INTEGRATIVE PROCESS Mathematical Note No. 351
W. C. Hoffman May 1964 59 p refs
(DI-82-0351; AD-602325) OTS: $3.00

A theoretical model for the visual integrative process is advanced that is based upon microelectrode studies of the animal visual cortex by Huble and Wiesel, Jung, and others. In this theoretical model the cortical columns of direction-sensing elements found by Hubel and Weisel are interpreted as sets of isoclines making up the visual field. The form of a visual image corresponds to a family of contours (orbits or paths, in the terminolgy of differential equations) that pass through those isoclines stimulated by the corresponding retinal regions. A contour of an image is thus approximated in the visual cortex as an isoclinic polygonal arc. Author

N64-29615 Kyoto U. (Japan) Research Inst. for Fundamental Physics
INTERNAL STRUCTURE AND SYMMETRY OF ELEMENTARY PARTICLES, I, II. SYMMETRY AND INTERNAL SPACE–TIME OF ELEMENTARY PARTICLES
Hideki Yukawa and Yasuhisa Katayama Jun. 1964 14 p refs
(RIFP-39)

In previous papers, elementary particles with internal structure were described collectively in terms of the nonlocal field or of the operators, depending on the external space–time coordinates and the internal space–time coordinates. In this report, it is shown that in this simple field model of operators there is an unexpected new internal symmetry, which could be identified with the symmetry in the isospin space. This was accomplished by finding a method of connecting the internal degrees-of-freedom in a bilocal field with the symmetry that was useful for the systematization of elementary particles. In ensuing developments, an alternative method of deducing the isospin operators—a method that does not require recourse to nonunitary representations of the operators, was derived; two equivalent descriptions of the internal space–time are given. These descriptions, which apply to Minkowski metric and Euclid metric, give the characteristic combination of the operators derived from broken SU_3 symmetry. I.v.L.

N64-29635 California U., La Jolla
FREE ENERGY OF THE ANTIFERROMAGNETIC LINEAR CHAIN
Robert B. Griffiths 18 May 1964 11 p refs
(Contract Nonr-2216(11))
(TR-20; AD-601847)

Rigorous upper and lower bounds for the free energy of the antiferromagnetic Heisenberg linear chain are obtained from general convexity properties of the free energy. The lower bound is derived; the upper bound was obtained previously by Bulaevskii. Both are compared with the calculations of Bonner and Fisher for finite chains. Author

N64-29652 Union Carbide Corp., Tonawanda, N.Y. Linde Div.
THEORETICAL, EXPERIMENTAL, AND ANALYTICAL EXAMINATION OF SUBCOOLED AND SOLID HYDROGEN Final Report, Nov. 15, 1962–Dec. 15, 1963
R. R. Carney, R. F. Dwyer, H. M. Long, and L. R. Niendorf Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., May 1964 256 p
(Contract AF 33(657)-10248)
(APL-TDR-64-22; AD-602609) OTS: $6.00

Methods were investigated, both theoretically and experimentally, for production of liquid–solid mixtures of hydrogen (hydrogen slush). Small-scale experiments were conducted to determine the feasibility of a number of techniques; the practicability and costs for these methods were determined theoretically. The theoretical analyses showed that techniques for producing hydrogen slush by vacuum pumping appeared most practical in view of capital investment and operating costs. Injection of cold helium gas was determined to be the most promising method for upgrading the solid content of slush mixtures after transfer to flight vehicle tankage. Liquid–solid hydrogen mixtures were produced having solid contents ranging from 20% to 55%. A number of characteristics were noted that varied with the production techniques used and with attempts to upgrade the quality of the slush produced. Some mixtures were flowable, and others were not. Author

N64-29654 Portugal Nuclear Energy Commision, Sacavem Laboratorio de Fisica e Engenharia Nucleares
MEASUREMENT OF SPECTRAL INDICES BY OSCILLATION [MESURE D'INDICES DE SPECTRES PAR OSCILLATION]
Eduardo Martinho 1964 43 p refs
(LFEN-NI12 (β))

The use of the oscillation method to measure spectral indices of neutrons overcomes many of the disadvantages of the activation method. The precision of the oscillation method is more satisfactory if the choice of the core configuration obeys certain optimization conditions, such as maximum sensitivity to absorbed neutrons, firm elevated spectra, and weak space coefficient. The formulas of Wescott expressing the density of neutrons, neutron flux, and reaction rates are reviewed, and certain deficiencies are noted. The theory and apparatus for the oscillation method are described, and results are given for samples exposed to maximum flux as well as for unexposed samples. Having calculated the vertical and horizontal flux distribution for the cavity, it is shown that the spectral index values determined by the oscillation method are comparable to those obtained by the activation method in the vicinity of maximum flux. M.P.G.

N64-29678 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
SPEED, ACCELERATION, WEIGHTLESSNESS
P. K. Isakov and R. A. Stasevich 10 Jun. 1964 148 p refs Transl. into ENGLISH of the book "Skorosti, Uskoreniya, Nevesomost'" Moscow, Voyennoye Izd. Ministerstva Oborony SSSR, 1962
(FTD-MT-63-103; AD-602335)

A popular review of new data on speed, acceleration, and weightlessness as related to problems of aviation and astronautics is presented. Influences of accelerations on the human organism, and the physical conditions arising from weightlessness under space-flight conditions are included. M.P.G.

N64-29683 Tem-pres Research, Inc., State College, Pa.
SMALL ANGLE X-RAY SCATTERING: METHODS AND CONSIDERATIONS
John A. Williams, Bert Phillips, H. A. Mc Kinstry, and G. E. Rindone (Pennsylvania State U.) 15 Jun. 1964 41 p refs
(Contract Nonr-4089(00))
(TR-3; AD-602781) OTS: $2.00

Various experimental considerations, such as collimation systems, monochromatization of the X-ray beam, and detection of the scattered X-rays are described, especially with reference to the Kratky collimation arrangement. The effects of parasitic scattering and sample thickness on the results in a scattering investigation are indicated. Author

N64-29684 Istituto Universitario Navale, Naples (Italy)
SCATTERING FROM PLANE INHOMOGENEOUS LAYERS
Giorgio Franceschetti 15 Sep. 1963 41 p refs
(Contract AF 61(052)-589)
(TN-3; IUN-1-EM; AD-602463)

The problem of scattering from plane, infinite, inhomogeneous layers, arbitrarily terminated, under normal or oblique incidence, is studied. The problem can always be solved via a Riccati differential equation. This equation is studied and approximately solved in two limiting cases (slow varying media and quasi-static case). The solutions are discussed in detail. Author

N64-29711 Argentina Comision Nacional de Energia Atomica, Buenos Aires

SOME OSBSERVATIONS ON POTENTIAL URANIUM-GRAPHITE GAS-COOLED REACTORS [ALGUNAS OBSERVACIONES SOBRE LOS REACTORES DE POTENTIA TIPO U NATURAL-GRAFITO-GAS]

Bela Jose Csik 1964 68 p refs In SPANISH *Its* Informe no. 102

Gas-cooled reactors that use natural uranium as fuel together with a graphite moderator were analyzed. The observations describe the general character of such reactors, with special reference to those used by Great Britain and the generation of nuclear-electric energy by reactors of this type. The problems of fuel, shielding, construction, and installation of these reactors are discussed. The economic features of gas-cooled reactors are also reviewed, and costs are analyzed to determine the feasibility of installing such a GCR in Argentina.

Trans. by D.E.R.

N64-29716 Rocketdyne, Canoga Park, Calif.

THE EMISSIVITY OF THE ROCKETDYNE CIRCULAR APERTURE BLACKBODY RADIATION SOURCE

P. Schumacher Feb. 1963 40 p refs

(Contract AF 19(604)-8066)

(RR-63-3; AD-442857)

The problem of emissivity determination of the blackbody radiation source has been investigated. It was concluded that experimental measurements with instrumentation available would result in emissivity values accurate only to within several percent. Three theoretical approaches—essentially those of Gouffé, Buckley, and DeVos—were briefly reviewed and used to calculate an effective emissivity for the source in question. The values were as follows: Gouffé, 0.9972; Buckley, 0.99935; and DeVos, 0.98064. The principal reason for the considerably lower value obtained with the DeVos theory is the fact that the nonuniformity of temperature throughout the cavity is taken into account, and therefore, this value is the most accurate one.

Author

N64-29770* Illinois U., Urbana

THE RESTRICTED PROBLEM OF THREE BODIES

James H. Bartlett Copenhagen, Roy. Danish Acad. Sci. and Letters, 1964 54 p refs Published as Mat.-Fys. Skr. Dan. Vid. Selsk, v. 2, no. 7, 1964

(Grant NsG-280-63) Available from Ejnar Hunksgaard, 6 Nörregade, Copenhagen K, Denmark: 3.00 Kr.

The case of two equal finite masses has been studied extensively, using Thiele variables, a modified Runge–Kutta method, and an electronic computer. The main classes of Stromgren have been traced continuously from beginning to end, and seven new classes are reported. For convenience, a class is represented by an eigensurface in (E, F, K) space, where K is the Jacobi integral. General methods of locating periodic solutions, in particular asymmetric ones, are discussed. Initial and final conditions, in the form of tables and curves, are given for more than 800 periodic orbits.

Author

N64-29773 Argonne National Lab., Ill. Chemistry Div.

CALCULATED VALUES OF WING–FONG'S NUCLIDIC MASS EQUATION

James Wing and Judith D. Varley May 1964 114 p refs

(Contract W-31-109-ENG-38)

(ANL-6886) OTS: $2.25

Wing and Fong have developed a semiempirical equation to describe the mass systematics of the atomic nuclides. It was found that their equation agrees fairly well with the available experimental data. Compared with several other existing nuclidic mass formulas, the Wing–Fong equation has the fewest number of large deviations from the experimental values and very few systematic deviations. The Wing–Fong mass equation expresses the mass excess, M, in terms of the mass number, A, and proton number, Z, of a nuclide, in units of million electron volts and the scale of C^{12} = 12.000000 mass units.

Author

N64-29774 Argonne National Lab., Ill.

REACTOR DEVELOPMENT PROGRAM Progress Report

Albert V. Crewe, Stephen Lawroski et al 20 Aug. 1964 103 p refs

(Contract W-31-109-ENG-38)

(ANL-6923) OTS: $2.25

Technical progress in the following reactor projects and general engineering research and development programs is summarized: (1) boiling-water reactors; (2) liquid-metal-cooled reactors—fast-reactor physics, fact-reactor fuel development, fast-reactor fuel-reprocessing development, sodium coolant chemistry; (3) general reactor technology—experimental reactor and nuclear physics, theoretical reactor physics, high-temperature materials development, remote-control engineering development, heat engineering, chemical separations, plutonium recycle reactor; (4) advanced-systems research and development—Argonne advanced-research reactor, magnetohydrodynamics, regenerative EMF cells; and (5) nuclear safety—thermal-reactor safety studies, fast-reactor safety studies.

P.V.E.

N64-29775 Atomic Energy of Canada, Ltd., Chalk River, Ontario Chalk River Nuclear Labs.

PHYSICS DIVISION PROGRESS REPORT, APRIL 1–JUNE 30, 1964

[1964] 61 p refs

(AECL-2044; PR-P-62)

Among the research areas discussed are the following: (1) space physics research—intensity variations observed in cosmic radiation; (2) solid-state physics—studies of the normal-vibrations in a single crystal of Mo, using the triple-axis crystal spectrometer at the NRU reactor; (3) a study of the reaction $F^{19}(d,n\ \gamma)$ with a lithium-drifted germanium counter; (4) space physics; (5) beta-ray spectroscopy; (6) lattice dynamics of Mo; (7) normal vibrations in beta-brass; (8) the thermal expansion of silicon; (9) $Hg^{199}(n,\gamma)Hg^{200}$ linear polarization correlation; and (10) theoretical physics.

I.v.L.

N64-29776 Hahn-Meitner Inst. für Kernforschung, Berlin (W. Germany)

RELEASE OF XENON FROM GRAPHITE MATRIX URANIUM CARBIDE (RARE-GAS DIFFUSION IN SOLIDS 13)

P. Schmeling Apr. 1964 24 p refs

(Contract Euratom-094-62-9 RDD)

(EUR-1454.e; EURAEC-854) Available from Belgium Am. Bank and Trust Co., N.Y., Account no. 121.86: 40 Belg. Fr.

A graphite-matrix fuel containing uranium carbide particles was investigated. The release of Xe-133 was studied in a number of multitemperature PAD (postactivation diffusion) experiments. The release pattern was found to be complicated and often not reproducible with different specimens of the same preparation and pretreatment. A comparison is made between the observed release pattern and those found by other investigators, and an approximate release mechanism corresponding to all experimental facts is proposed.

Author

N64-29777 European Atomic Energy Community, Brussels (Belgium)
ACTIVATION ANALYSIS TECHNIQUES AT THE JOINT RESEARCH LABORATORIES AT ISPRA
May 1964 79 p
(EUR-1601.e) Available from Belgian Am. Bank and Trust Co., N.Y., Account no. 121.86: 125 Belg. Fr.

The Activation Analysis Laboratory at the Joint Research Center of Ispra is routinely analyzing numerous elements in research on nuclear technology, biology, solid-state physics, etc. This report has been prepared mainly for scientists with no special radiochemical background. The principles, the techniques, and the equipment employed by the laboratory are described; the possibilities of activation analysis for all the elements are then discussed. Author

N64-29785* General Electric Co., Cincinnati, Ohio Flight Propulsion Lab.
INTRODUCTION TO NUCLEAR PROPULSION. LECTURE 2: BASIC PHYSICS
Gunnar Thornton 26 Feb. 1963 32 p refs
(Contract NAS8-5215)
(NASA-CR-52960; GEMP-190b) OTS: $3.60 ph

This lecture covers some of the elementary nuclear-physics concepts that will be useful in future lectures. These concepts deal with atomic structures and nuclear particles, nuclear reactions, radiation-field intensity, cross sections, reaction rates, and the production and disintegration of radioactive isotopes. I.v.L.

N64-29786* General Electric Co., Cincinnati, Ohio Flight Propulsion Lab. Dept.
SUMMARY OF DIFFUSION THEORY FOR HOMOGENEOUS AND HETEROGENEOUS NUCLEAR REACTORS Lectures 3 and 4, Mar. 5–7, 1963
J. R. Beeler, Jr. [1963] 114 p refs
(Contract NAS8-5215)
(NASA-CR-52959; GEMP-190C) OTS: $9.60 ph

Two lectures on the theory of homogeneous and heterogeneous nuclear reactors are presented. The diffusion theory is the main topic of discussion. Ideas on which elementary reactor theory is based are discussed, and results are given for the one-group and two-group diffusion theory approximations. These lectures provide the basis for constructing a rudimentary design of a slow reactor. No proofs or derivations are given in the coverage, but the lectrure notes point out where proofs and derivations can be found. The appendixes pertain to multigroup equations, the perturbation theory, elastic collisions, and some standard kernels. I.v.L.

N64-29787* General Electric Co., Cincinnati, Ohio Flight Propulsion Lab. Dept.
INTRODUCTION TO NUCLEAR PROPULSION: SHIELD PHYSICS Lectures 5 and 6, Mar. 12–14, 1963
John Moteff [1963] 69 p
(Contract NAS8-5215)
(NASA-CR-52958; GEMP-190D) OTS: $6.60 ph

Basic radiation physics is summarized, including gamma-ray cross section, neutron cross section, relaxation length, radiation units, and radiation dosimetry and conversion. Shielding calculation methods are described, including narrow-beam attenuation, broad-beam attenuation with buildup, inverse square law, radiation from shielded distributed source with self-absorption, heat generation in shields, and scattering of radiation. R.L.K.

N64-29788* General Electric Co., Cincinnati, Ohio Flight Propulsion Lab. Dept.
INTRODUCTION TO NUCLEAR PROPULSION: REACTOR SYSTEMS DESIGN Lectures 7 and 8, Mar. 19–21, 1963
Russell E. Motsinger [1963] 80 p refs
(Contract NAS8-5215)
(NASA-CR-52957; GEMP-190E) OTS: $7.60 ph

The topic of these two lectures is concerned with the factors involved in the design of a nuclear reactor, particularly concerning how one approaches the problem of designing a reactor system for a new application without limiting the discussion to rocket application. The basis for this lecture is the experience gained during the aircraft nuclear propulsion effort that, in many respects, required a degree of design sophistication, as did the nuclear rocket. I.v.L.

N64-29790* General Electric Co., Cincinnati, Ohio Flight Propulsion Lab. Dept.
INTRODUCTION TO NUCLEAR PROPULSION: MECHANICAL DESIGN Lectures 11 and 12, Apr. 9–11, 1963
Otto G. Woike [1963] 213 p refs
(Contract NAS8-5215)
(NASA-CR-52955; GEMP-190G) OTS: $14.50 ph

A discussion of the mechanical design of gas-cooled high-temperature nuclear reactors is presented. Design problems peculiar to this application are stressed. The GE-ANPD reactor designs, described in a previous paper, are used to illustrate the mechanical aspects. Emphasis is placed on the ceramic reactor design. Ceramic reactors considered are beryllium moderated (the beryllium being in the form of BeO) and fueled with fully enriched uranium (the uranium being in the form of UO_2). Fuel elements are in the shape of small tubes fabricated from a basic ceramic matrix of UO_2, uniformly dispersed in BeO. Various additives and cladding are used to perform special functions. The technology described is based upon the development of ceramic reactors to be used in direct aircycle nuclear turbojets. Appendixes are attached that pertain to an elastic thermal stress analysis—thermal stresses directly associated with the extraction of power from an individual element in the reactor and the corresponding bench-test simulation of this problem; the temperature dependence of material properties—a linearized thermal-expansion approach; and the viscoelastic behavior of BeO. I.v.L.

N64-29818 Electro-Mechanics Co., Austin, Tex.
TECHNIQUES OF MULTIMODAL ANALYSIS IN WAVEGUIDES EMPLOYING A SEMI-INFINITE SLAB OF MERCURY Final Report
Lars N. Engel et al Griffiss AFB, N.Y., RADC, Jul. 1964 70 p refs
(Contract AF 30(602)-2902)
(RADC-TDR-64-248; AD-604412)

This study consists of an examination of a unique technique for measuring the modes within a waveguide. The technique provides for electric field intensity measurements in a waveguide by using a pool of mercury as one side of a waveguide section. A movable probe needle, which projects above the mercury pool, measures the fields within the waveguide. The research includes the calculation of parameters governing voltage breakdown due to the presence of mercury vapor; the comparison of voltage standing wave ratio measurements obtained from a slotted waveguide with the measurements obtained from the mercury waveguide; transverse electric field measurements obtained by moving the probe across the broad wall of the mercury waveguide at the fundamental, second, and third harmonics; the development of a multimode launcher; and the development of a multimode load. Author

N64-29837 California Inst. of Tech., Pasadena Quantum Electronics Lab.
ROTATIONAL MODES IN SPHERICAL-MIRROR RESONATORS Scientific Report No. 2
Walter A. Specht, Jr. Jun. 1964 44 p refs
(Contract AF 49(638)-1322)
(AFOSR-64-1311; AD-604690)

This work is the examination of a cavity mode approach to the mode structure of a laser. The solution of the vector wave equation for rotational fields in and between oblate spheroidal cavities is examined for the case of wavelengths much less than cavity dimensions. These solutions are rotational field modes in Fabry–Perot-type resonators with equal-radius concave spherical mirrors, or with concave–convex spherical mirrors, when the parameters of the oblate spheroids are chosen so that the radii of curvature and spacing on the axis of rotation match those of the resonator mirrors. Expressions for the transverse and longitudinal rotational mode structures are derived. The eigenvalue equations are written and are solved for the case of the two lowest order modes. Author

N64-29854 Naval Radiological Defense Lab., San Francisco, Calif.
EVIDENCE AGAINST A WEAK COUPLING MODEL FOR ^{57}FE
C. S. Cook 12 May 1964 8 p refs
(USNRDL-TR-742; AD-601625)

A number of nuclear models have been explored during recent years in attempting to explain the energy levels of the nuclide ^{57}Fe, but none of these can be fitted to the experimental data with really significant precision. Another possible nuclear model is discussed in which the low-lying excited energy levels are formed from coupling the last odd neutron of ^{57}Fe to the quadrupole vibrational state of the remaining core of nucleons, a core-excited state model. Although some aspects of the physical properties of ^{57}Fe appear to fit such a model, the relative number of such agreements is not significantly greater than for other models. Author

N64-29858 RAND Corp., Santa Monica, Calif.
THE KOMPANEETS MODEL FOR RADIO EMISSION FROM A NUCLEAR EXPLOSION
V. Gilinsky Aug. 1964 23 p refs
(RM-4134; AD-603709)

The electromagnetic signal from a nuclear explosion is computed, using the same method as presented by Kompaneets. It is shown that some of Kompaneets' approximations are incorrect and lead to the wrong shape for the radiated signal. His work neglects the important first half-cycle of the signal and hence predicts an initial deflection in the wrong direction. A more correct solution is presented. Author

N64-29875 Naval Radiological Defense Lab., San Francisco, Calif.
GAMMA AND X-RAY EFFECTS IN MULTIPLIER PHOTOTUBES
H. A. Zagorites and D. Y. Lee 7 Jul. 1964 29 p refs
(USNRDL-TR-763; AD-603228)

The effects of gamma and X-radiation exposure rate have been determined in 4 common multiplier phototube types over an intensity range of about 1 to 10^{10} r/hr. Radiation-induced anode current was essentially a linear function of exposure rate up to about 10^4 r/hr and reached values of 10^{-4} to 10^{-3} amp at 10^5 r/hr steady state. Above 10^5 r/hr, peak values of anode current as high as 50 ma were observed with pulsed X-rays of 0.2 μsec duration. The output of all tubes was essentially space-charge-limited at peak exposure rates greater than 10^7 to 10^8 r/hr; however, anode current recovery time to the preirradiation levels in three tube types increased with exposure rate, and recovery times of 6 μsec to 30μsec were observed at 10^{10} r/hr. The principal radiation sensitivity of all tubes was due to radiation-induced luminescence of the face plates and glass envelopes, and tube response increased with anode luminous sensitivity. Author

N64-29883 Portugal Nuclear Energy Commission, Sacavem Lab. de Fisica e Engenharia Nucleares
DETERMINATION OF THE PROMPT NEUTRON LIFETIME OF THE "REACTOR PORTUGUES DE INVESTIGACAO (RPI)" [DETERMINACAO DA VIDA DOS NEUTROES PRONTOS NO REACTOR PORTUGUES DE INVESTIGACAO (RPI)]
Glenn S. Bronson (Argonne Natl. Lab.) and Jaime M. C. Oliveira 1964 37 p refs In PORTUGUESE; ENGLISH summary
(LFEN-16 (α))

Using an oscilloscope as a time analyzer and one conventional fission counter channel, the prompt neutron lifetime of the "Reactor Português de Investigação (RPI)" has been measured by the Rossi–alpha method. Conditions were marginal because of a substantial photoneutron source resulting from (γ, n) reactions by fission product gammas. However, the result (48 ±4) microseconds is in reasonable agreement with a calculated value of 52.8 microseconds. It is shown that the Rossi–alpha results can be used to estimate the intensity of the irremovable neutron source; in this case it was found to be $\sim 7 \times 10^3$ neutrons per second. Author

N64-29930 Utah State U., Logan Electro-Dynamics Labs.
RECOGNIZING PATTERNS IN PHOTOGRAPHS Scientific Report No. 1
C. K. Rushforth 1 May 1964 20 p refs
(Contract AF 19(628)-3825)
(AFCRL-64-640; AD-604656)

The problem of recognizing patterns in photographs is considered. It is assumed that the patterns to be classified are exactly known, and that the photograph is sampled and quantized to form a binary vector. The optimum classification procedure for the general case involves nonlinear data processing on this vector. In two important special cases, however, this optimum procedure reduces to one that uses correlation or matched-filter techniques. The analysis applies not only to the specific problem described here, but to any situation in which the patterns to be classified may be represented by binary vectors provided the appropriate assumptions are satisfied. An important example is the so-called property-list description of a pattern. Author

N64-29944 Brookhaven National Lab., Upton, N.Y.
NUCLEAR ENGINEERING DEPARTMENT PROGRESS REPORT, SEPTEMBER 1–DECEMBER 31, 1963
Jean H. Reynolds, ed. Jun. 1964 116 p
(BNL-841(S-86)) OTS: $2.25

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N64-29954* Naval Research Lab., Washington, D.C. Radiation Div.

COULOMB APPROXIMATION OSCILLATOR STRENGTHS OF SPECTRAL LINES FROM LIGHT AND MEDIUM ELEMENTS

H. R. Griem 16 Jun. 1964 27 p refs
(NASA Order R-9; Grant NSF GP-1376)
(NRL-6085; AD-603312)

This report contains a comprehensive table of absorption oscillator strengths for many spectral lines from various ionization stages of most elements between, and including, Li and Ca, which have been calculated with the Coulomb approximation for the radial matrix elements, assuming LS-coupling. An average accuracy of 30% is suggested for visible lines emitted from neutral atoms. For ultraviolet lines, larger errors must be expected, with the accuracy improving as the degree of ionization increases. Absorption oscillator strengths for the lines in many of the strongest multiplets of the various spectra have also been included in the table. Author

N64-29958 Naval Research Lab., Washington, D.C. Nuclear Reactions Branch

REGULARITIES IN THERMAL NEUTRON ABSORPTION CROSS SECTIONS

S. Podgor and L. A. Beach 21 Jul. 1964 11 p refs
(NRL-6124; AD-604195) OTS: $0.50

Thermal neutron absorption cross sections have generally not been considered to show much systematics. However, some regularities are brought out in this report that have not been stated before. Each stable odd Z_i–even N_j nucleus has a higher cross section than the corresponding even $(Z_i - 1)$–even N_j nucleus, with very few exceptions. The odd Z nuclei show a pronounced cyclic variation in cross section, while the corresponding even Z nuclei have considerably less variation. Justifications for these rules are presented on the basis of the existence of a pairing force in the nucleus. Author

N64-29997 Physical Studies Inc., Centerville, Ohio

INELASTIC DISSOCIATIVE AND CHARGE EXCHANGE SCATTERING OF PROTONS BY NITROGEN Final Report

R. G. Breene, Jr. 10 May 1964 89 p refs
(Contract AF 19(628)-2925)
(AFCRL-64-338; AD-604448)

Various channels for the collision of protons with nitrogen atoms are considered via the impact parameter treatment. In all cases the energy of the incident proton ranges from 1 to 50 Kev. The cross sections are first computed for three channels for the population of the upper state of the first positive system through the transition to the mixed in singlet portion of the B state, the spin flip transition to the B state, and the spin flip transition to the B' state and subsequent radiative transition to the B state. The cross section for the collisional dissociation into two doublet D nitrogen atoms is calculated. The effect of certain approximations are outlined analytically. Author

N64-29998* Massachusetts Inst. of Tech., Cambridge Research Lab. of Electronics

[A REVIEW OF THE RESEARCH ACTIVITIES ON RADIO PHYSICS, PLASMA DYNAMICS, AND COMMUNICATION SCIENCES AND ENGINEERING] Quarterly Progress Report No. 74

H. J. Zimmermann and G. G. Harvey 15 Jul. 1964 299 p refs
(Grants NsG-496; NSF GP-2495; NIH-MH-04737-04; NSF-G-24073; Contracts AT(30-1)-1842 et al)
(AD-603870)

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N64-30003 California Research Corp., La Habra

THE REFRACTED ARRIVAL FROM A LAYER Scientific Report No. 6

T. W. Spencer 15 Jun. 1964 64 p

(Contract AF 19(604)-8344; ARPA Order 180-61)

(AFCRL-64-608; AD-604447)

High-frequency geometric ray theory is used to investigate the refracted arrival from a high-speed layer embedded in an infinite medium. The effect of changing the layer thickness to dominant wavelength ratio (E/λ_d) and the range to depth ratio (ρ/H) is analyzed for a point compressional source. The results approximate the exact solution when $E/\lambda_d \geq 1$. The theory predicts shingling and shows that it is distance limited. The maximum distance at which shingling is observed decreases as E/λ_d decreases. Beyond a certain minimum distance, the refracted arrival consists of a superposition of waves whose phase velocities approach the compressional velocity in the layer at large distances. These waves include the reflected waves that cross the layer at least once in the compressional mode and the head waves that are generated by reflected waves that do not cross the layer in the compressional mode. Author

N64-30022 Boeing Scientific Research Labs., Seattle, Wash. Plasma Physics Lab.

CLASSIFICATION OF MEDIA

Paul Rolland May 1964 17 p refs

(DI-82-0347; AD-602323) OTS: $1.00

The paper of Polovin does not clarify all the difficulties in the theory of Sturrock. With these remarks and supplements, a complete connection is established between the theory of Sturrock and the analytical method developed by the present writer. It is shown that for the absolute instability, the demonstration of Polovin has to be completed to avoid an ambiguity. For evanescence, the boundary conditions introduced by Polovin must not be independent, so that some root gives a zero contribution; for absolute instability, it would be impossible to introduce any boundary conditions. Author

N64-30023 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

ATOMIC ENERGY Selected Articles

25 Jun. 1964 24 p refs Transl. into ENGLISH from Atomnaya Energ. (Moscow), v. 15, no. 2, 1963 p 120–130

(FTD-MT-64-171; AD-602398)

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N64-30040 Naval Ordnance Lab., White Oak, Md.

ELECTRIC SUSCEPTIBILITY CONTRIBUTION TO VERDET'S CONSTANT OF ATOMIC HYDROGEN

Jack Finkel Jul. 1964 12 p refs

(NOLTR-64-87; AD-602968) OTS: $1.00

The electric susceptibility contribution to Verdet's constant of atomic hydrogen V_e is derived for Zeeman splittings that are much smaller than the fine structure splitting but greater than the hyperfine splitting. Neglect of the electron spin in this calculation would result in a value for V_e, which is 18.2% low. The contribution to V_e from the continuous states is 6.8% of the contribution from the discrete states, at a wavelength of 6,000 A. The total Verdet constant at 6,000 A, including the magnetic susceptibility contribution, for 2.69×10^{19} atoms per cm^3 is 10.8μ-min/cm/oersted. The experimental value of Verdet's constant of molecular hydrogen under these conditions is 5.82μ-min/cm/oersted. This difference in Verdet's constant between atomic and molecular hydrogen can be used to determine the atomic concentration in a mixture. Author

N64-30045 California U., Livermore Lawrence Radiation Lab.

INFORMATION INTEGRATION SYSTEM FOR LRL-L PROGRAM ON MAN-MADE RADIATION IN THE BIOSPHERE

Arthur R. Tamplin and Jason L. Minkler 15 Jul. 1964 62 p

(Contract W-7405-ENG-48)

(UCRL-795-T) OTS: $1.50

Objectives of the program are as follows: (1) the development of more adequate models for predicting the distribution of radionuclides within the biosphere subsequent to their release, regardless of the location; and (2) the development of countermeasures that prevent either their access to man or their accumulation or retention in the vital organs and tissues of the body. To accomplish these objectives, three projects were established: (1) experimental, (2) theoretical, and (3) information integration. The paper is concerned with the third project, which is essentially the development of a research tool to facilitate problem solution in the shortest time period with optimum utilization of personnel. Procedures for coding are discussed, and flow charts for system operation are appended. A.W.

N64-30048* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

EFFECTIVE RADIUS OF A CESIUM ATOM IN GROUND STATE AND FIRST EXCITED STATE

Samuel Kampos Washington, NASA, 1964 5 p refs

(NASA-TM-X-52057) OTS: $1.10 ph

The effective radius of neutral cesium in the ground state and in the first excited state has been calculated through the use of Stone's wave functions. The values are 2.98 and 4.12 A for the 6s and 6p states, respectively. An application of the radial information is made to cesium polarizability calculations. Author

N64-30049* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ON SOUND INTENSITY AND SOUND PRESSURE LEVELS
Willi H. Heybey 22 Apr. 1964 25 p refs
(NASA-TM-X-53035) OTS: $2.60 ph

Sound propagation through the open atmosphere is studied mainly for an estimate of the acoustical energy that sound rays sent up by static firings and refracted back to ground level may transmit to inhabited areas. A theoretical expression derived in an earlier report for the volume density of returned energy is converted into an expression for the corresponding intensity level to accommodate it to engineering practice. A first approximation of the latter's relationship to the sound pressure level (as an observable quantity) is established. The results of the theory can thus be compared to those of field measurements by microphones, and a basis for theoretical prediction is prepared. Author

N64-30063 Oak Ridge National Lab., Tenn. Reactor Div.
AN INVESTIGATION OF THE INFLUENCE OF THE HOLD-UP EFFECT OF DOUBLE CONTAINMENT ON REACTOR HAZARDS
T. D. Anderson (M.S. Thesis—Tennessee U.) Sep. 1964 75 p refs
(Contract W-7405-ENG-26)
(ORNL-3657) OTS: $1.75

This report contains conclusions as to the effectiveness of double-containment holdup in reducing hazards associated with the release of airborne radioactive materials to the environment after a reactor accident. There are eight chapters, as follows: (1) "Introduction"; (2) "Containment Model"; (3) "Containment System Leak-Rate"; (4) "Dose-Rate and Dose"; (5) "Dose Reduction"; (6) "Increase in Allowable Reactor Power"; (7) "Application"; and (8) "Summary." A.W.

N64-30082* Cornell U., Ithaca, N.Y. Center for Radiophysics and Space Research
THE STABILITY OF IONIZATION FRONTS
W. I. Axford Repr. from Astrophys. J., v. 140, no. 1, 1 Jul. 1964 p 112–118 refs
(Grant NsG-382)

The problem of the stability of ionization fronts is considered, making an allowance for the absorption of ionizing photons in the H II region. For weak D-type ionization fronts it is found that the absorption has a stabilizing effect, and that only very short wavelength disturbances remain unstable. A complication, which at present prevents an analysis of the stability of strong D-type ionization fronts, is discussed briefly. Author

N64-30087* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE INTERNATIONAL SYSTEM OF UNITS. PHYSICAL CONSTANTS AND CONVERSION FACTORS
E. A. Mechtly 1964 24 p refs
(NASA-SP-7012)

This document gives definitions of the basic units of the Systeme International d'Unites (designated SI in all languages) and tables of factors for converting from U.S. customary units. This coherent system, based on the meter, kilogram, second, and ampere, was accepted as the preferred system of units by representatives of 36 countries, including the U.S., in February 1964. M.P.G.

N64-30088* National Aeronautics and Space Administration, Washington, D.C.
TRANSACTIONS OF THE MEETINGS OF THE ELEVENTH GENERAL CONFERENCE ON WEIGHTS AND MEASURES
Sep. 1964 208 p Transl. into ENGLISH of Compt. Rend. Des Seances de la Onzieme Conf. Gen. Des Poids et Mesures, Paris, 11–20 Oct. 1960
(NASA-TT-F-217) OTS: $3.50

A detailed report is given on the commentaries, proposals, and final resolutions adopted at the Eleventh General Conference on Weights and Measures held in Paris, France, in October 1960. Five sessions were held, and agreements were reached concerning international standards for use by the nations represented. Author

N64-30103* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio
SUPERPOSITION CALCULATION OF THICK SOLENOID FIELDS FROM SEMI-INFINITE SOLENOID TABLES
Gerald V. Brown and Lawrence Flax Washington, NASA, Sep. 1964 50 p refs
(NASA-TN-D-2494) OTS: $1.75

A simple method is given for calculating the magnetic-field components in or around any finite solenoid by superposition of fields of semi-infinite solenoids with zero inner radius. Nondimensional expressions for the radial and axial field components are derived for a semi-infinite solenoid carrying uniform current density. Values of these nondimensional fields have been computed and are presented in tables and in graphs. Author

N64-30135 Rochester U., N.Y. Inst. of Optics
SOME DEMONSTRATION EXPERIMENTS IN OPTICS USING A GAS LASER
David Dutton, M. Parker Givens, and Robert E. Hopkins Oct. 1963 26 p refs
(Grant NSF-G-22941)

Some elementary experiments in geometrical and physical optics, usually limited to individual observations in the laboratory, can be adapted for presentation to larger groups as lecture or classroom demonstrations, by making use of the gas laser as a light source. This paper describes several such experiments dealing with lens aberrations, interference and diffraction phenomena, and the Abbe theory of the microscope, together with some practical optical systems for performing them. Author

N64-30191* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio
NEUTRON SELF-SHIELDING FACTORS FOR MULTIPLE-BODY CONCENTRIC CYLINDRICAL CONFIGURATIONS
Thor T. Semler Washington, NASA, Sep. 1964 20 p refs
(NASA-TN-D-1587) OTS: $0.50

Monte Carlo calculations of the self-shielding factors for multiple-body concentric cylindrical geometries are made, and the results are compared with the rational approximation and other analytic results. The blackness for a monoenergetic neutron flux incident upon an infinite length cylindrical shell of absorber with central internal rods of absorber and multiple concentric ring configurations are calculated by means of the Monte Carlo method. A cosine incident-angular-neutron distribution and one collision model are chosen. The probability of absorption is calculated for thin shell and central rod combinations and for multiple concentric cylinders for a range of macroscopic absorption cross sections. The self-shielding

factors computed for these configurations are compared with the results of the rational approximation as well as other analytic results. Author

24 PHYSICS, PLASMA

Includes fusion; and magnetohydrodynamics. *For related information see*: 05 Astronomy and Astrophysics; 23 Physics, General; and 25 Physics, Solid-State.

N64-29030 Wisconsin U., Madison Mathematics Research Center

PULSATING MAGNETOHYDRODYNAMIC FLOW SUPERPOSED ON THE STEADY LAMINAR MOTION OF AN INCOMPRESSIBLE VISCOUS FLUID IN AN ANNULAR CHANNEL

M. N. L. Narasimhan Feb. 1963 23 p refs
(Contract DA-11-022-ORD-2059)
(MRC-TSR-379; AD-401216)

Discussed is pulsating laminar flow superposed on the steady motion of a viscous, incompressible, electrically conducting fluid in an annular channel between two, infinitely long, circular cylinders under a radially impressed magnetic field. The general magnetohydrodynamic equations are simplified by the conditions of the problem to three equations in pressure, velocity, and magnetic field. One equation gives the pressure variation in the radial direction; the other two are coupled equations for the velocity and magnetic field, which are functions of the radial variable only. The solutions of these equations have been obtained in terms of Kelvin and Lommel functions, and the velocity profiles are examined for different values of the frequencies of pulsation. Author

N64-29062 Israel Program for Scientific Translations, Ltd., Jerusalem

IRREGULARITIES IN THE PLASTIC DEFORMATION OF CRYSTALS [NERAVNOMERNOSTI PLASTICHESKOI DEFORMATSII KRISTALLOV]

V. N. Rozhanskii *In its* Advan. in Phys. Sci., v. 65, nos. 1–4, May–Aug. 1958 1964 p 280–301 refs (See N64-29052 21-23) $5.75

The slip mechanisms, which are dominant at stresses near the yield point in plastic deformation, are discussed. Particular attention is given to the connection between the manifestations of deformation irregularities and the formation of microcrack nuclei. The paper is divided into the following particular areas of discussion: (1) localization of the plastic deformation; (2) abrupt deformation; (3) deformation and electric conductivity; (4) formation of microcrack nuclei; (5) the connection between strain hardening and strength; and (6) surface tension and mechanical properties. P.V.E.

N64-29080 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

FIELD STRENGTH ON THE SURFACE OF A BODY IN PLASMA

A. V. Gurevich *In its* Cosmic Res., v. 2, no. 2 8 Jun. 1964 p 87–108 refs (See N64-29076 21-01)

The structure of a charged layer at the surface of the body in plasma is investigated. The value for field strength at the surface of the body is determined. It is shown that measurements of field strength at the surface of the body can be used for determining the directional velocity of ion movement in the ionosphere. Author

N64-29122 Advisory Group for Aeronautical Research and Development, Paris (France)

ARC HEATERS AND MHD ACCELERATORS FOR AERODYNAMIC PURPOSES

Leon E. King Aug. 1964 168 p refs Papers from Session of the AGARD Specialists Meeting, Rhode-Saint-Genese, Belgium, 21–23 Sep. 1964
(Contract AF 40(600)-1000)
(AGARDograph-84, Suppl.)

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3. IMPROVEMENTS IN DESIGN OF MHD ACCELERATOR CHANNELS FOR AERODYNAMIC PURPOSES John B. Dicks (ARO, Inc.) p 127–174 refs (See N64-29125 21-24)

N64-29123 ARO, Inc., Arnold Air Force Station, Tenn.

GENERAL CONSIDERATIONS OF MHD ACCELERATION FOR AERODYNAMIC TESTING

Leon E. Ring *In* AGARD ARC Heaters and MHD Accelerators for Aerodyn. Purposes Aug. 1964 p 1–55 refs (See N64-29122 21-24)

Estimates of magnetohydrodynamic (MHD) accelerator performance limitations are made and show that velocities of 30,000 to 40,000 ft/sec at high density should be attainable with a Faraday accelerator. Operation near atmospheric pressure using seeded air is suggested; order-of-magnitude estimates indicate the seed material should not affect most aerodynamic testing. The possibility of increased performance by use of nonequilibrium electrical conductivity is discussed. Author

N64-29124 ARO, Inc., Arnold Air Force Station, Tenn.

DEVELOPMENT OF A STEADY-FLOW JxB ACCELERATOR FOR WIND TUNNEL APPLICATION

K. E. Tempelmeyer, A. K. Windmueller, and L. E. Rittenhouse *In* AGARD ARC Heaters and MHD Accelerators for Aerodyn. Purposes Aug. 1964 p 57–126 refs (See N64-29122 21-24)

Electrical discharge and material tests have been made in a supersonic seeded nitrogen plasma at static temperatures and pressures near 3,000° K and 1 atm, respectively. The plasma electrical conductivity appeared to be influenced by nonequilibrium, elevated electron-temperature effects. Cooled copper electrodes set flush in a wall could be made to carry sufficient electrical currents to make MHD acceleration feasible, while still having negligible erosion. Sprayed beryllium oxide was found to be the best insulation material of those tested for the conditions at which a high-pressure accelerator must operate. The design of a water-cooled accelerator having 117 pairs of segmented electrodes, and the initial success of proof tests with a prototype 20-pair electrode accelerator are described. Author

N64-29125 ARO, Inc., Arnold Air Force Station, Tenn.
IMPROVEMENTS IN DESIGN OF MHD ACCELERATOR CHANNELS FOR AERODYNAMIC PURPOSES
John B. Dicks (Tenn. U.) *In* AGARD ARC Heaters and MHD Accelerators for Aerodyn. Purposes Aug. 1964 p 127–174 refs (See N64-29122 21-24)

The formulation of a different theoretical model of magneto-hydrodynamic (MHD) accelerators and generators, along with generator experiments of the University of Tennessee Space Institute and accelerator experiments at Arnold Center, indicates that it is possible to design a channel of much simpler construction, higher temperature capability, and an order-of-magnitude less expensive than those initially considered. Author

N64-29185* IIT Research Inst., Chicago, Ill.
RADIATIVE ENERGY TRANSFER ON ENTRY INTO MARS AND VENUS Quarterly Report No. 8
William O. Davies Aug. 1964 27 p refs
(Contract NASr-65(01))
(NASA-CR-58574; IITRI-T200-8) OTS: $2.60 ph

The dissociation rate of CO has been measured for temperatures of 7,000° to 9,000° K. The rate of CO disappearance behind shock waves in a CO-Ar gas mixture was monitored by observing the infrared radiation from the CO fundamental vibration band at 4.65μ. The dissociation rates expressed in an Arrhenius equation and classical collision theory (in cm^3/particles-sec) are, respectively,

$$k = (5.80)\ 10^{-12}\ T^{1/2} \exp(-8.00\ ev/kT), \text{ and}$$

$$k = (9.38)\ 10^{-13}\ (D/kT)^{3.88} \exp(-D/kT),$$

where D is the CO dissociation energy, k is the Boltzmann constant, and T is the absolute temperature. A rate constant was also determined from observations of emission from the CO (3,0) Triplet band, on the assumption that the population in the CO ($d^3\Delta)_{v=3}$ energy level, excited by collisions of the second kind between CO($X^1\Sigma$) molecules and A(^3P) atoms, is proportional to the total CO population. Author

N64-29205* National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York, N.Y.
A. C. CONDUCTIVITY OF A PLASMA
C. S. Shen, and R. L. W. Chen Repr. from J. Nucl. Energy Pt. C, v. 6, 1964 p 389–399 refs
(NASA-RP-304)

This paper computes the electrical conductivity of a fully ionized, spatially homogeneous plasma under the influence of a uniform, periodically alternating electric field. The velocity distribution of the electrons is determined by solving the linearized Fokker–Planck equations. All the terms in the collision integral are retained, including those representing electron–electron interactions. The resultant values of conductivity are expected to be valid in the range of frequencies from zero to below the plasma frequency. Author

N64-29236 Aeronautical Research Council (Gt. Brit.)
THE INFLUENCE OF GAS STREAMS AND MAGNETIC FIELDS ON ELECTRIC DISCHARGES. PARTS I AND II
V. W. Adams London, HMSO, 1964 73 p refs
(ARC-CP-743; Replaces RAE-TN-AERO-2896; ARC-25085)
HMSO: 14s

This paper describes an experimental study of the motion and electric properties of a d.c. arc moving around an annular gap under the action of a magnetic field. The dependence of the motion on the arc current, magnetic field, and gap width is given for values up to 750 amps, 940 gauss, and 3.2 cm, respectively. The electrical characteristics of a fixed current arc are given for fields up to 940 gauss. Photographic evidence of the arc rotation together with an indication of the shape of the conducting path is also included. Author

N64-29299 General Dynamics Corp., San Diego, Calif. General Atomic Div.
ANALYSIS OF IONIC AND NEUTRAL SPECIES IN THERMAL PLASMAS Final Report, Jun. 1, 1963–May 31, 1964
M. A. Fineman 24 Aug. 1964 24 p refs
(Contract AF 19(628)-3242)
(GA-5401; AFCRL-64-515; AD-446245)

A discussion of the importance of a knowledge of the nature and concentrations of the various cesium neutral and ionic species in cesium thermionic energy converters is given. The apparatus employed to analyze the ionic and neutral species in cesium thermal plasmas is described. A brief analysis of the many factors that must be considered to get reliable data on the concentrations of the various cesium species in the plasma is also included, and some preliminary results of the study of the cesium beam effusing from the source chamber are presented. The appearance potentials of multiply charged cesium ions obtained from atomic cesium by electron bombardment are compared with results of other workers. A study of the ionization efficiency curve of Cs_2^+ showed that two different electron impact processes gave rise to this molecular ion. Author

N64-29348 Mechanical Technology, Inc., Latham, N.Y.
THE STABILITY OF FLOW BETWEEN CONCENTRIC CYLINDRICAL SURFACES WITH A CIRCULAR MAGNETIC FIELD
R. C. Di Prima and C. H. T. Pan May 1964 19 p refs
(Contract Nonr-3731(00)(FBM))
(MTI-64TR25; AD-601487)

The stability of a viscous, electrically conducting fluid confined between two infinitely long concentric cylinders that are either rotating (the Taylor problem) or for which there is a circumferential pressure gradient (the Dean problem) in the presence of a circular magnetic field has been the subject of a number of investigations. In this note the known results are briefly summarized for the purpose of clarity and completeness. Also, new results for the Dean problem with conducting and nonconducting walls are given. The present computations indicate that the eigenvalue problem can be solved satisfactorily by using the Galerkin method with simple sets of polynomials for the expansion functions. All of the previous theoretical investigations, as well as the present one, are limited to the small-gap case, where it is assumed that the gap between the cylinders is small compared to the mean radius. Author

N64-29354 Nagoya U. (Japan) Inst. of Plasma Physics
SCATTERING OF MICROWAVES FROM A PLASMA COLUMN IN RECTANGULAR WAVEGUIDES
Hideo Ikegami Apr. 1964 53 p refs
(IPPJ-27)

The microwave reflection method for the measurement of various parameters of cold plasma is examined. The exact solutions are obtained for the waves scattered by a plasma column inserted in the duct. The probing electric field of TE_{10} mode is parallel to the axis of the column. The

emphasis is placed on the fact that inhomogeneous electron density distribution is fully taken into account. The electron density in the column is assumed to be

$$n(2) = n_0 \left(1 - \frac{r^2}{\rho^2}\right).$$

where ρ is the radius of the column and n_0 is the electron density on the axis of the column. The electric permeability is then locally defined with use of n(r). Author

N64-29405* Case Inst. of Tech., Cleveland, Ohio Plasma Research

MEASUREMENTS ON CURRENT SHEETS IN PLASMAS

O. K. Mawardi and M. Naraghi Oct 1962 17 p refs

(Grant NsG-198-62)

(NASA-CR-58649; TR-A-2) OTS: $1.60 ph

The acceleration of a gas undergoing ionization in a crossed electric–magnetic field leads to the formation of current sheets similar to those observed in coaxial plasma guns. A detailed mapping of the magnetic field in the vicinity of a current sheet is described. Conventional small search coils are used for the detection of this field. From the configuration of this field an attempt is made to understand the processes taking place in the sheet. All of the experiments described are performed on a plasma coaxial gun of small aspect ratio. Author

N64-29415 Oak Ridge National Lab., Tenn.

PHASE EQUILIBRIUM STUDIES IN THE SYSTEM UC_2-ThC_2

N. A. Hill and O. B. Cavin Sep. 1964 18 p refs

(Contract W-7405-ENG-26)

(ORNL-3668)

The results of high-temperature X-ray diffraction coupled with differential thermal analysis, isothermal annealing, and the examination of structures at room temperature by metallography and X-ray powder patterns of a range of uranium dicarbide–thorium dicarbide arc-melted alloys have been used to identify the phases found and their areas of stability. A tentative equilibrium diagram section for these alloys in the presence of excess graphite has been constructed. At high temperatures; a single face-centered cubic phase was found at all compositions. On cooling to a temperature, depending on composition (1,820° C for UC_2, 1,420° C for ThC_2, and 1,110° C for a 50/50 mixture), the alloys transformed to a low-temperature structure. No major variation was found in melting temperature as a function of composition. Author

N64-29437 Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center

LONG LIFE CLOSED LOOP MHD RESEARCH AND DEVELOPMENT UNIT Quarterly Technical Progress Report 1 Mar.–31 May 1964

R. L. Hundstad, F. A. Holmes, S. Way, and M. G. Fey Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., 28 May 1964 36 p refs

(Contract AF 33(657)-8311)

(QTPR-9; AD-601255)

The second test of the closed-loop verified the reliability and versatility of the peripheral equipment and measuring instruments. Details of the second test are presented, along with a description of the present status of the ceramic lined end returns. The estimated loop performance calculations have been made for two additional temperatures, thereby giving a more complete theoretical picture of its capabilities. Author

N64-29452* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

RESONANT INTERACTION OF VERTICALLY POLARIZED PLANE ELECTROMAGNETIC WAVES WITH THIN SLABS OF PLASMA

Paul D. Rowley and Virginia L. Sorensen Washington, NASA, Sep. 1964 26 p refs

(NASA-TN-D-2476) OTS: $0.75

An obliquely incident, vertically polarized (TM), plane electromagnetic wave may interact in a resonant manner with a thin slab of plasma if the collision frequency is small and the frequency of the incident wave is approximately equal to the plasma frequency. Two particular cases are considered. A conductor-backed thin slab of plasma may completely absorb an incident wave. A thin slab of plasma in free space strongly reflects an incident wave at this plasma resonant condition. For these cases and for most other boundary conditions for a homogeneous thin slab, the reflection coefficient taken as a function of frequency tends to follow a circle in the complex plane when near this resonant condition. The numerical solution of the interaction of plane electromagnetic waves with inhomogeneous plane stratified regions is discussed. Author

N64-29492* National Aeronautics and Space Administration, Washington, D.C.

INTERACTION OF AN EXPANDING CYLINDRICAL PLASMA WITH AN EXTERNAL MAGNETIC FIELD [O VZAIMODEYSTVII RASSHIRYAYUSHCHEGOSYA PLAZMENNOGO SHNURA S VNESHNIM MAGNITNYM POLEM]

V. I. Yakovlev Sep. 1964 12 p refs Transl. into ENGLISH from Zh. Prik. Mekhan. i Tekhn. Fiz. (Moscow), no. 6, 1963 p 14–143

(NASA-TT-F-234) OTS: $0.50

An examination is made of the interaction between an expanding plasma column and a constant magnetic field, and the dependence of the internal efficiency $\eta_i = (A - Q)/A$ on R_m alone is investigated for two special cases of the given hydrodynamics of expansion of the plasma. The A is the work done by the plasma against the electromotive force per unit of time, and Q is the intensity of the joulean losses in the plasma. The quantities A and Q relate to a unit length of the plasma column. Author

N64-29493* National Aeronautics and Space Administration, Washington, D.C.

THE FLOW OF AN ELECTRICALLY CONDUCTIVE FLUID IN A PLANE MAGNETOHYDRODYNAMIC CHANNEL [TECHENIYE ELEKTROPROVODNOY ZHIDKOSTI V PLOSKOM MAGNITOGIDRODINAMICHESKOM KANALE]

I. P. Zimin Sep. 1964 11 p refs Transl. into ENGLISH from Zh. Prik. Mekhan. i Tekhn. Fiz. (Moscow), no. 6, 1963 p 108–112

(NASA-TT-F-242) OTS: $0.50

The flow of an electrically conductive fluid between two flat, infinite, parallel, nonconductive plates, in the presence of a transverse magnetic field perpendicular to the plane of the plates, was first studied by Hartman. Subsequently the problem was generalized to include the case of vertical convection and the flow of a fluid with anisotropic conductivity. With this formulation, the field of velocities between cylinders is determined by an external magnetic field; then the known solution for the velocity field is employed in a search for the induced magnetic field. This article deals with an analogous flow in the case where the magnetic field intensity vector lies in a plane parallel to the plates, and the plates are conductive. Author

N64-29498* National Aeronautics and Space Administration, Washington, D.C.
THE SPIRAL MOTION OF AN ELECTRICALLY CONDUCTIVE GAS BETWEEN COAXIAL PERMEABLE CYLINDERS IN THE PRESENCE OF A LONGITUDINAL MAGNETIC FIELD [SPIRAL'NOYE DVIZHENIYE ELEKTROPROVODNOGO GAZA MEZHDU KOAKSIAL'NYMI PRONITSAYEMYMI TSILINDRAMI PRI NALICHII PRODOL'NOGO MAGNITNOGO POLYA]
I. B. Chekmarev and I. I. Shakhnov Sep. 1964 9 p refs Transl. into ENGLISH from Zh. Prik. Mekhan. i Tekhn. Fiz. (Moscow), no. 6, 1963 p 3–6
(NASA-TT-F-240) OTS: $0.50

The stationary rotational motion of an electrically conductive gas between infinitely long coaxial cylinders in the presence of an external magnetic field has been examined repeatedly in the literature. In this connection, if the assumption of incompressibility of the medium makes it possible to solve the problem in quadratures, then allowance for compressibility of the gas leads to the necessity for numerical integration of the equation for the radial component of velocity. Where compressibility has been allowed for, no determination of the component in question has been made. It is precisely the radial component of velocity that determines the blocking effect in a channel, when the continuity of the gas-dynamic parameters of the flow is disrupted. The article is a study of the characteristics of the flow, based on the assumption that there is no blocking in the channel. Author

N64-29499* National Aeronautics and Space Administration, Washington, D.C.
CERTAIN PROBLEMS CONCERNING THE MOVEMENT OF A CONDUCTIVE FLUID IN A PLANE CHANNEL [NEKOTORYYE ZADACHI DVIZHENIYA PROVODYASHCHEY ZHIDKOSTI V PLOSKOM KANALE]
A. Ye. Yakubenko Sep. 1964 11 p refs Transl. into ENGLISH from Zh. Prik. Mekhan. i Tekhn. Fiz. (Moscow), no. 6, 1963 p 7–12
(NASA-TT-F-241) OTS: $0.50

The Wiener–Hopf method is used to solve two problems connected with the flow of a conducting fluid in a flat channel. In the first problem a study is made of the motion of a semi-infinite plate in an electrically conducting fluid enclosed between two parallel planes in a transverse magnetic field. In the second problem a study is made of the flow of a fluid between parallel walls that are half dielectrics and half ideal conductors. Author

N64-29529 Stanford U., Calif. Stanford Electronics Labs.
TWO-STREAM INTERACTION IN GAPS AND HELICES
George Lawrence Sackman Jan. 1964 86 p refs
(Contract AF 33(657)-11144)
(SU-SEL-63-137; AL-TDR-64-66; AD-60202) OTS: $2.25

The interaction of two codirected streams with the fields of a cavity is considered theoretically and experimentally, and shows that for the range of electronic transit angles normally encountered in a gap, the loading resistance due to the two coupled beams is almost a superposition of the loading effect of the individual streams considered separately. The growing space-charge waves that occur in a codirected two-stream system were found to have little effect in most situations. A theory of the interaction of two oppositely directed streams coupled to a gap or to a slow-wave transmission line is developed, and an experiment is described that consists of two concentric hollow beams with oppositely directed velocities inside a helix. Results of theory and experiment show that for matched terminations to the helix, bidirectional amplification can take place without oscillation. Oscillation occurs only if relatively large mismatches are introduced, and then only at transit angles corresponding to monotron oscillation for a single beam. Author

N64-29562* Massachusetts Inst. of Tech., Cambridge
EXPLORER 10 PLASMA MEASUREMENTS
A. Bonetti, H. S. Bridge, A. J. Lazarus, B. Rossi, and F. Scherb [1962] 124 p refs
(Contract NASw-75)
(NASA-CR-58670) OTS: $10.10 ph

A plasma moving with a velocity of about 300 km sec^{-1} was first observed when the satellite reached a distance of about 22 earth radii. During the remainder of the observations (which terminated about 40 hours later, at a distance of 42 earth radii) periods in which substantial plasma fluxes were recorded alternated with shorter periods in which the plasma flux was below or just above the detection limit. There was a striking correlation between the plasma flux and the magnetic field: in the absence of plasma the magnetic field direction was nearly radial from the earth, where in the presence of plasma the field was irregular and generally formed large angles with the earth-satellite direction. Author

N64-29648 Boeing Scientific Research Labs., Seattle, Wash. Plasma Physics Lab.
TWO-STREAM INSTABILITY IN A FINITE LENGTH
Richard Gerwin and Donald J. Nelson Mar. 1964 49 p refs
(DI-82-0332; AD-602321) OTS: $3.00

Two contrastreaming electron beams of equal densities and speeds interacting between two parallel planes are studied. The streams are cold, and their average charge is compensated by a uniform positive background. For infinitely broad streams, an eigenfrequency equation is derived from the conditions that the entering beams be free of perturbations. The eigenfrequency equation is solved numerically, and the results show there is no instability for $\omega_b\tau < \pi/2^{3/2}$, where ω_b is the plasma frequency of either beam, and τ is half the transit time between the plates. For large values of $\omega_b\tau$, the fastest-growing modes have a growth rate of $\omega_b/2$. The growth rate is also calculated from the dispersion relation assuming appropriate real values of wavenumber and is in good agreement with the exact results of the eigenfrequency equation. Author

N64-29662* Maryland U., College Park
KINETIC THEORY OF THE CLASSICAL ELECTRON GAS IN A POSITIVE BACKGROUND. I: EQUILIBRIUM THEORY
Ralph L. Guernsey Repr. from Phys. Fluids, v. 7, no. 6, Jun 1964 p 792–802 refs
(Grant NsG-220-62)

An approximation scheme is developed for calculating the equilibrium properties of a system containing both short-range and weak long-range interactions. The results are applied to the calculation of the pair correlation and equation of state for an electron gas in a neutralizing background. Although the starting point is the Bogoliubov–Born–Green–Kirkwood–Yvon hierarchy, the short-range divergence usually encountered in the "dynamic" approach is avoided, and the results (calculated through second order in the plasma parameter) are found to be in agreement with previous calculations by diagrammatic methods. Author

N64-29689* Princeton U., N.J. Guggenheim Labs. for the Aerospace Propulsion Sciences
PULSED ELECTROMAGNETIC GAS ACCELERATION Fourth Semi-Annual Progress Report, 1 Jan.–30 Jun. 1964
Robert G. Jahn 31 Jul. 1964 46 p refs
(Grant NsG-306-63)
(NASA-CR-58567; Rept.-634C) OTS: $4.60 ph

Experimental study of the initiation and development of the current pulses in large-radius pinch discharges has been facilitated by the construction of a 5-inch, tubular, pinch-generating device. This machine is capable of producing essentially impermeable, cylindrical current sheets that are coupled to the external circuit over most of their inward excursion. Streak and Kerr-cell photography, photoelectric spectroscopy, and magnetic and electric probes have revealed many of the interior details of these current pulses, and an auxiliary electrode containing a central orifice leading to a glass vacuum chamber has permitted optical observation of the exhaust plume. A lumped-line type of pulse-forming circuit has been developed to drive another discharge chamber. This device permits the application of current and voltage waveforms of prescribed profiles to the pinch discharges. Author

N64-29828 Microwave Associates, Inc., Burlington, Mass.
MAGNETICALLY CONTROLLED GAS DUPLEXER Fourth Quarterly Progress Report, 27 Nov. 1963–27 Feb. 1964
C. S. Ward Griffiss AFB, N.Y., RADC, Aug. 1964 29 p refs
(Contract AF 30(602)-2960)
(RADC-TDR-64-229; AD-604755)

Measurements of discharge arc loss in helium as a function of gas pressure and transverse magnetic field are described. The discharge tube was incorporated in a cavity resonator, and loss measurements were made by monitoring the cavity gain at resonance. Results indicate that for $p_0 \leq 1$ torr, magnetic fields in excess of 600 gauss will produce 60% to 70% reductions in discharge arc loss. The power levels at which these data were obtained are extrapolated to show that the results are valid for balanced ATR duplexing at 45 mw peak, 75-kw average. Author

N64-29833 National Bureau of Standards, Boulder, Colo. Central Radio Propagation Lab.
ON RADIATION OF ELECTROMAGNETIC AND ELECTRO-ACOUSTIC WAVES IN PLASMA Scientific Report No. 29
James R. Wait 8 Jun. 1964 17 p refs
(Contract AF 19-PRO-62-201)
(AFCRL-64-473; AD-604435)

Radiation from current distributions in a lossless compressible plasma media is considered. A linearized theory is used such that the isotropic electron plasma is regarded as a single fluid continuum. A considerable portion of the power is radiated as an electroacoustic-type wave. Some specialized results of other investigators are re-covered. Author

N64-29898 Boeing Co., Seattle, Wash. Scientific Research Labs.
COLLISION-INDUCED INSTABILITY IN A PLASMA WITH AN ISOTROPIC VELOCITY-SPACE DISTRIBUTION
J. E. Drummond, J. Nelson, and J. L. Hirshfield (Yale U.) [1963] 18 p refs
(Contract AF 19(628)-2448; Grant NSF GP-186)
(DI-82-0273; AD-421009)

A dispersion law for the propagation of longitudinal and transverse waves in an electron plasma is derived using the Boltzmann equation with a collision term representative of isotropic, recoilless, elastic, binary scattering of the electrons. For a spatially homogeneous plasma, the unperturbed velocity-space distribution is thus isotropic. Taking a collision frequency ν that varies with speed v as $\nu(v) = \text{const.}\ v^h$, a class of collision-induced instabilities can arise if $-3 > h > +3$. The growth rate of these instabilities is largest for an infinite wavelength perturbation. The results for transverse waves agree with an earlier derivation that used the relaxation approximation to describe the collisions. Author

N64-29912 Wisconsin U., Madison Mathematics Research Center
TRANSIENT MAGNETOHYDRODYNAMIC FLOW IN AN ANNULAR CHANNEL
M. N. L. Narasimhan Feb. 1963 21 p refs
(Contract DA-11-022-ORD-2059)
(MRC-TSR-381; AD-401188)

Unsteady parallel flow of an electrically conducting viscous incompressible fluid in an annular channel in the presence of a radial transverse magnetic field is considered. Assuming the fluid to be at rest at the initial moment, the velocity distribution and magnetic field components are obtained in terms of Bessel and Lommel functions and in the form of convolution integrals taking the longitudinal pressure as an arbitrary function of time. Further, taking a step function for the pressure gradient, these expressions are integrated. The influence of the magnetic field on the annular flow is investigated. Some numerical examples are given. Author

N64-29919 RAND Corp., Santa Monica, Calif.
THE SCATTERING OF ELECTROMAGNETIC WAVES FROM PLASMA CYLINDERS, PART II
Phyllis Greifinger Jul. 1964 48 p ref
(ARPA SD-79; ARPA Order 189-61)
(RM-3574-ARPA; AD-444792)

This memorandum considers the long-wavelength limit of the scattering of electromagnetic radiation in the transverse magnetic mode by infinite plasma cylinders with radially varying electron-density distributions. Techniques for calculating the scattering cross section are described for both increasing and decreasing electron-density distributions. Resonance phenomena peculiar to increasing electron-density distributions are discussed in some detail with specific numerical examples. A résumé is presented of methods that can be used to calculate the scattering cross section for radiation of arbitrary wavelength for monotonically decreasing electron-density distributions. Examples are given for the gaussian electron distribution. Author

N64-29949 Joint Publications Research Service, Washington, D.C.
LIQUID METAL IN AN ELECTROMAGNETIC FIELD
I. M. Kirko 18 Sep. 1964 138 p refs Transl. into ENGLISH of the book "Zhidkiy Metall v Elektromagnitom Pole" Moscow-Leningrad, 1964 p 1–160
(JPRS-26459; TT-64-41717) OTS: $4.00

Magnetohydrodynamic phenomena in liquid metals and in electrolytes located in an electromagnetic field are discussed. Industrial and technical applications of these phenomena in electromagnetic pumps, mixers, melting without crucibles, etc., are considered. A.W.

N64-29966 Advanced Kinetics, Inc., Costa Mesa, Calif.
PLASMA KINETIC ENERGY–RF CONVERSION Final Report
R. W. Waniek, R. T. Grannan, D. G. Swanson, L. L. Wentzel, W. C. Miller et al Griffiss AFB, Ohio, RADC, Jul. 1964 68 p refs
(Contract AF 30(602)-2981)
(RADC-TDR-64-174; AD-604120)

A theoretical and experimental program is described aimed at studying the possibility of extracting microwave power from the kinetic energy of a plasma. The appropriate theoretical framework is established with the description of a radiating blackbody and the emission by bremsstrahlung collisions. A detailed analysis of the cyclotron radiation by a single electron and by an electron population of Maxwellian distribution is given. Problems are discussed covering the frequency distribution of the power spectrum over the harmonics and the angular distribution of the radiation. The solution of the more generalized formulation for the radiation output is indicated. Author

N64-29971 Polytechnic Inst. of Brooklyn, Farmingdale, N.Y. Graduate Center
DIRECT CONVERSION OF PLASMA KINETIC ENERGY TO R.F. ELECTROMAGNETIC ENERGY Final Report
E. Levi, J. Freidberg, and M. Sandler Griffiss AFB, N.Y., Rome Air Develop. Center, Aug. 1964 105 p refs
(Contract AF 30(602)-2980)
(PIBMRI-1224-64; RADC-TDR-64-265; AD-605266)

This work has produced the following: (1) a novel mathematical technique that makes it possible to follow the development with time of disturbances and the formation of shocks in magnetized plasmas; (2) the discovery of hitherto unknown wave propagation modes that satisfy the two-fluid nonlinear-plasma dynamical equations; and (3) the experimental detection of radiative modes in an impulsively excited toroidal discharge. Author

N64-30007 Aerospace Corp., El Segundo, Calif. Plasma Research Lab.
GENERAL RESEARCH: EXPERIMENTAL OBSERVATIONS OF KADOMTSEV INSTABILITY IN A HIGHLY IONIZED HELIUM PLASMA
D. A. Mc Pherson 31 Jul. 1964 33 p refs
(ATN-6-(9230)-2; AD-604893)

Experimental observations of the Kadomtsev current-convective interaction between a hydromagnetic wave and an electrical current have been made, using a highly ionized helium plasma to verify the theoretical analysis of Woods. According to theory, the damping of the wave should be modified by the addition of a term, the sign of which depends upon the sense of circular polarization of the wave. Data have been taken to determine the dependence of this term upon electrical current, wave frequency, conductivity gradient, and wave polarization. In all instances, the experimental observations are in agreement with the theoretical predictions. Author

N64-30041 Boeing Scientific Research Labs., Seattle, Wash. Plasma Physics Lab.
LIFETIMES OF NONEQUILIBRIUM CARRIERS IN MAGNETIC TRAPS
Betsy Ancker-Johnson and Michael F. Berg Apr. 1964 12 p refs
(DI-82-0340; AD-602322) OTS: $0.50

Nonequilibrium electrons and holes in approximately equal density are produced in p-InSb at 77° K by forcing a current greater than ohmic through the sample. The density decays exponentially after an initial rapid decay occurring in $\lesssim 200$ nanosec. The lifetime in the exponential region is 0.92 ± 0.05 μsec in the nonequilibrium carrier density range 0.9 to 2.1 x $10^{13}cm^{-3}$ when no magnetic fields are applied. The excess carrier density in the presence of a magnetic trap compared with that in its absence after a given decay time is observed to be enhanced by as much as 65%. The trap configuration used in these measurements is achieved by superposition of three static fields: (1) a uniform axial one, H_a; (2) a symmetric non-uniform axial field emanating from two current coils located one each in the planes of the sample ends, H_{em}, where em signifies "end mirror"; and (3) an axially symmetric transverse field in the form of a quadrupolar cusp, H_{wm}, where wm signifies "wall mirror." Author

N64-30068 Nihon U., Tokyo (Japan)
APPLICABILITY OF PERTURBATION TREATMENT TO NONDEGENERATE PLASMAS
Setsuo Misawa [1964] 16 p refs
(NUP-64-7)

In the scattering between two electrons in vacuo, the Coulomb interaction can be regarded as a perturbation (i.e., the Born approximation) only when $e^2/hv << 1$, where v is the relative velocity. In actual plasmas, additional factors arise. The interaction between any two electrons is no longer the original Coulomb potential but is given by the screened Coulomb interaction in the presence of the other electrons, which act as a dielectric medium. As a result, the force range becomes finite, though there still exist a great number of particles in this force range. Because of this different situation and because of the strong correlation in nondegenerate plasmas, it becomes necessary to examine the applicability condition of the perturbation theory to these plasmas. This report conducts this examination by evaluating the self-energy of the electron, particularly its imaginary part, from the standpoint of the perturbation theory, since the imaginary part directly reflects the dissipative nature of the one-particle state. I.v.L.

N64-30075 Dynatech Corp., Cambridge, Mass.
ZERO GRAVITY CONTROL OF HYDROGEN AND CESIUM BY ELECTRICAL PHENOMENA Final Report
Mathew Hurwitz, E. John Fahimian, and John M. Reynolds Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Apr. 1964 176 p refs
(Contract AF 33(657)-10784)
(APL-TDR-64-46; AD-604365)

Investigations established the feasibility of dielectrophoretic separation and orientation of two-phase hydrogen in long-duration, large-scale, zero-g storage facilities. Laboratory analog tests were conducted that verified theoretical performance criteria. The KC-135 flight tests demonstrated the validity of the analog results. A generalized computer-aided program was instituted for designing dielectrophoretic storage systems optimized with respect to weight penalty. Worked examples are presented for 4,000-hr missions involving 2,000-, 4,000-, and 6,000-lb hydrogen payloads. Electrohydrodynamic (EHD) and magnetohydrodynamic (MHD) phenomena were investigated for control of liquid cesium. EHD methods are not feasible. Several MHD methods were investigated. Only the traveling-wave induction machine satisfies the requirements for cesium control in zero-g. Author

N64-30112 Aerospace Corp., El Segundo, Calif. Plasma Research Lab.
STUDY OF TURBULENCE IN AN ARC PLASMA JET USING ELECTROMAGNETIC INDUCTION
A. E. Fuhs 3 Aug. 1964 28 p refs
(Contract AF 04(695)-269)
(SSD-TDR-64-122; TDR-269(4280-50)-1; AD-605296)

Interaction of a turbulent conducting gas with a steady applied magnetic field drives fluctuating currents. The unsteady magnetic field arising from these currents induces a voltage in a sensing coil. An integral equation for the voltage and the related partial differential equation for the electrical potential are derived. A relation between signal rms magnitude and jet properties is discussed. Experiments were conducted using an arc plasma jet operating with argon. Most of the signal was due to frequency components in the interval 10 to 100 kc. By use of two transducers, one located downstream of the other, the average jet velocity was measured. The delay giving the peak value of the cross correlation function formed from the two signals was taken as the transit time. Methods for electronically determining the time delay are described. Author

N64-30119 Stanford U., Calif. Microwave Lab.
MODE COUPLING IN BOUNDED, COLD BEAM-PLASMA SYSTEMS Final Report
J. C. Eidson Griffiss AFB, N.U., RADC, Aug. 1964 133 p refs
(Contract AF 30(602)-3098)
(RADC-TDR-64-189; AD-605265)

This study is concerned with the problem of guided-wave propagation and electron-beam interaction in bounded systems containing a plasma. The model used in the study is a circular conducting guide partially filled with a uniform, stationary, zero-temperature plasma contained with a finite axial d.c. magnetic field. For the electron beam interaction study the beam is assumed to be of uniform cross section and perfectly neutralized. The modes that exist in such a system are studied from two points of view: (1) A detailed treatment using the quasi-static assumption is given. This treatment considers both symmetric and nonsymmetric modes and gives a unified picture of the possible modes of propagation. (2) The study of the modes is directed at including the effects of the divergence free fields that are neglected in the quasi-static approximation. A coupled mode approach and a variational technique are developed, giving results that approximate the exact solution quite closely. Author

N64-30151 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE INTERACTION OF SHOCK WAVES
R. A. Antonova, E. M. Barkhudarov et al 21 Aug. 1964 8 p refs
Transl. into ENGLISH from Zh. Tekh. Fiz. (Leningrad), v. 33, no. 9, 1963 p 1137–1138
(FTD-MT-64-19; AD-605241)

High-speed photography was used to study the interaction of shock waves. It was shown that the character of interaction is analogous to the interaction of a shock wave with a wall, since, in the case of a strong shock wave, the relationships for speeds of reflected and incident waves coincide with those calculated for the interaction of a shock wave with a wall. In some cases, an expansion wave was observed behind the front of the reflected wave. D.E.W.

N64-30158 Elcon Lab., Inc., Peabody, Mass.
INTERACTION OF ELECTROMAGNETIC WAVES AND CLASSICAL PLASMAS Monthly Report No. 10
Robert Siegel 15 Apr. 1964 5 p ref
(Contract AF 33(657)-11671)
(R-4-64-2; AD-602871)

The most important terms in the spherical harmonic expansion are the time- and space-dependent coefficients. Expressions for these functions have been derived with the following assumptions, as well as the justifications for them. The sum and difference frequency terms were assumed negligible; certain coefficients can be neglected if the alternating electric fields are not in the same direction as the concentration gradient in the plasmas. In addition, the diffusion coefficients were equated to zero on the grounds that experimental data could be obtained prior to the onset of these effects and after the pumping pulse. Other controllable experimental parameters for the anticipated experiments on cross-beam modulation were established. D.E.W.

N64-30164 Chicago U., Ill. Labs. for Applied Sciences
RESEARCH ON EFFECTS OF ARC FLUCTUATIONS ON SPECTROSCOPICALLY DETERMINED TEMPERATURES IN ARC PLASMAS Final Report
Jay Burns Wright-Patterson AFB, Ohio, AF Mater. Lab., Jul. 1964 56 p refs
(Contract AF 33(657)-10856)
(ML-TDR-64-243; AD-604886)

Results of time-resolved spectroscopic temperature measurements in small regions of a turbulent laboratory arc plasma generator are described. Techniques and instrumentation for carrying out time-resolved measurements are described. The effects of arc turbulence on apparent spectroscopic temperatures determined by conventional spectroscopic methods are demonstrated. The errors in average temperature measured by conventional spectroscopy as compared with the true average temperature in the same region of the arc determined by time-resolved spectroscopy are appreciable. No simple way has been found to determine true average temperatures in a turbulent arc plasma from apparent, conventional spectroscopic, average values. Author

N64-30172 Miami U., Coral Gables, Fla.
DIFFUSION OF PLASMAS ACROSS A MAGNETIC FIELD Plasma Physics Bulletin, Vol. I
Harry S. Robertson Mar. 1964 27 p refs
(Contracts AT(40-1)-2454; AF 19(628)-2844)
(AD-437524)

Experimental investigation of transport processes in cesium arc plasmas shows classical ambipolar diffusion across low magnetic fields, convective transport associated with the helical instability at intermediate fields, and a return, apparently to diffusive transport and relatively good confinement, at magnetic fields ten to twenty times the critical field for the onset of the instability. Improved confinement is also achieved by using a hysteresis in the parameter space of the plasma operation. Author

N64-30190 Stanford U., Calif. Microwave Lab.
RESEARCH AND INVESTIGATION OF SELECTED MICROWAVE PROBLEMS Interim Engineering Report No. 5, 1 Mar.–31 May 1964
Jul. 1964 14 p refs
(Contract AF 33(657)-11042)
(ML-1189; AD-443416)

Results are reported for the following continuing studies: (1) nonlinear radiation from plasma oscillations; (2) acoustic

wave interactions, including coupling to hypersonic waves, diffraction of light with hypersound, and generation of hypersound with laser light; (3) transverse wave devices involving θ-varying displacement waves rather than space-charge waves for fast-wave interaction with smooth waveguide circuits; (4) optical spectroscopy of laser materials; and (5) nonlinear quantum studies. M.P.G.

25 PHYSICS, SOLID-STATE

Includes semiconductor theory; and masers. *For related information see*: 09 Electronics; 23 Physics, General; and 24 Physics, Plasma.

N64-29021 Pennsylvania State U., University Park College of Mineral Industries
HIGH PRESSURE STUDIES OF THE SYSTEM GeO_2-SiO_2
W. S. Miller, F. Dachille, and R. Roy 30 Jan. 1963 18 p refs
(Contract Nonr-656(20))
(TR-8; AD-299842)

Isothermal studies were conducted on the system GeO_2-SiO_2 at high pressures. The observations were made on runs carried out in opposed anvil apparatus. In addition, some of the hydrothermal runs of Shafer and Roy were repeated, and new ones were made in order to complete the p-t-x representation of the phase relationship existing in the system. I.v.L.

N64-29095 Oak Ridge National Lab., Tenn. Research Materials Information Center
RMIC BULLETIN
Jun. 1964 59 p refs
(ORNL-RMIC-2)

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N64-29096 Oak Ridge National Lab., Tenn. Solid State Div.
GROWTH OF COPPER CRYSTALS OF LOW DISLOCATION DENSITY
F. W. Young, Jr., and J. R. Savage *In its* RMIC Bull. Jun. 1964 p 3–9 refs (See N64-29095 21-25)

Crystals (up to 1 in. × 6 in.) were grown from 99.999+% Cu by a Bridgman method and were examined for dislocation density by acid sawing and polishing slices with (111), (100), and (110) faces and using etch-pit techniques. The orientation of the growth axis of unseeded crystals was essentially random. A correlation between growth direction and crystal perfection was found, the dislocation density being an inverse function of the angular deviation of the growth direction from the (111) zone. Subsequent annealing of the slices at 1,075° C for 1 week reduced the dislocation density, and a number of samples with a dislocation density $< 5 \times 10^2/cm^2$ have been prepared. Author

N64-29097 Materials Research Corp., Orangeburg, N.Y.
THE PREPARATION OF HIGH PURITY SINGLE CRYSTALS FROM ELECTRON BEAM ZONE REFINED IRON
E. J. Hughes and P. W. Barton *In* Oak Ridge Natl. Lab. RMIC Bull. Jun. 1964 p 10–16 refs (See N64-29095 21-25)
(Contract AT(30-1)-2980)

The factors affecting the efficiency of the float-zone refining technique are discussed, and the application of electron-beam zone refining to the purification of iron is described. Using this technique, polycrystalline iron containing an average of <1 ppm, 7 ppm, and 8 ppm of nitrogen, carbon, and oxygen, respectively, has been consistently produced. The theory of the strain anneal technique for single crystal growth is discussed, and a method for growing single crystals from zone-refined polycrystalline material is described. The purity of the crystals was assessed by chemical analysis, mechanical property measurements at −196° C, and the measurement of the ratio of the resistivity at room temperature to that at 4.2° K. Author

N64-29241 Carborundum Co., Niagara Falls, N.Y. Research and Development Div.
PHASES AND TWINNING IN $C_2Al_3B_{48}$ (BETA AlB_{12})
V. I. Matkovich, R. F. Giese, Jr., and J. Economy Jun. 1964 17 p refs Submitted for Publication
(Contract Nonr-4075 (00))
(TR-2; AD-601709)

The aluminum–boron phase described recently as beta-AlB_{12} is shown to consist of two crystallographically related, intergrown phases with the bulk stoichiometry of $C_2Al_3B_{48}$. One phase (A) is orthorhombic with a = 12.34 A, b = 12.631 A and c = 5.08 A and space group Cmma or C2ma. The other phase (B) is also orthorhombic with a = 6.17, b = 12.631, and c = 10.161 and space group Ammm, A222, or A2mm. Twinning is always present and occurs across the (110) and (1$\bar{1}$0) faces. The high-temperature phase (C) is tetragonal with a = 8.82 A, b = 5.09 A, and space group P4/nmm, P4/n or $P4_2/n$. The transformation, which is reversible, is gradual and complete at about 850° C. Author

N64-29250 Materials Research Corp., Orangeburg, N.Y.
VARIATION OF PROPERTIES OF FINE WIRES WITH DIAMETER Technical Documentary Report, May 1–31, 1963
G. Abowitz, E. Hughes, P. Barton, and R. Vigue Wright-Patterson AFB, Ohio, ASD, Aug. 1964 29 p refs
(Contract AF 33(657)-9178)
(ASD-TDR-63-641; AD-602532)

The growth of face-centered-cubic wire single crystals utilizing the strain anneal technique has been investigated, and the values of the various parameters in the process were determined. With the exception of aluminum, annealing twins were produced in all the metals examined during the gradient anneal and acted as obstacles to migrating grain boundaries. Copper crystals 0.020-in. diameter grown by the above technique have been shown to have a preferred orientation, i.e., with their major axis parallel to [100]. This is the cube texture commonly developed in cold worked and annealed copper. Electro- and chemical-thinning experiments on single crystals of copper grown from both the liquid and

the solid have met with some success and are continuing. Etch pit studies have revealed pits on (111) faces of copper crystals grown by a modified Bridgman technique. Author

N64-29276 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE CHANGE IN THE MAGNETIC PROPERTIES OF SOLID INORGANIC COMPOUNDS IN A FIELD OF INTENSE γ-RADIATION
S. V. Stardubtsev and I. M. Blaunshteyn 19 Jun. 1963 12 p refs Transl. into ENGLISH from the book Vsesoyuznogo Soveshchaniya Po Radiatsionnoy Khimii Moscow, Izd. Akad. Nauk SSSR, no. 2, 1962 p 683–687
(FTD-TT-63-424/1+2+4; AD-414504)

The changes in magnetic properties of certain inorganic compounds, which were subjected to gamma-irradiation, were investigated. Both ionic and ionic-covalent compounds, as well as certain elements with pronounced semiconductor properties, were among the substances investigated. The magnetic changes were in diamagnetic, paramagnetic, and antiferromagnetic susceptibility. Results of the investigation are discussed and are presented in tabular form. Three conclusions were made: (1) The magnetic susceptibility of many inorganic compounds changes when irradiated with gamma irradiation. (2) The data obtained are of a qualitative nature and do not claim to represent complete and unique interpretations. (3) A study of the change in susceptibility of irradiated substances yields additional knowledge about the character of radiation disturbances. I.v.L.

N64-29328 Stanford Research Inst., Menlo Park, Calif.
TUNNEL CATHODES FOR MICROWAVE TUBES Interim Report, 1 Dec. 1962–28 Feb. 1963
D. V. Geppert and B. V. Dore Mar. 1963 31 p refs
(Contract AF 33(657)-8721)
(IR-3; AD-299013)

The problem of the high sheet resistivity of the gold-surface film was solved. This enabled meaningful current-voltage data to be taken on Au-CdS-Au structures. Irreversible current increases during testing occurred, and were attributed to a dielectric breakdown of the binder coating around the CdS particles. Thicker films were tested, however, and avalanching was not observed. Methods of preparing CdS films by means other than spraying were studied. Several important improvements in our laboratory facilities have been made, and other improvements are in process. Further work has been done on the calculation of the mean free path of hot electrons in metals. In addition, the techniques used for metals has been used to determine the relaxation frequency of hot electrons and hot holes in semiconductors. Author

N64-29344* Rensselaer Polytechnic Inst., Troy, N.Y.
EFFECT OF PRESSURE ON THE INFRARED SPECTRA OF SOME HYDROGEN-BONDED SOLIDS
Joseph Reynolds and Sanford S. Sternstein Repr. from the J. of Chem. Phys., vol. 1, 1 Jul. 1964 5 p refs
(Grant NsG-100-60)

By using a diamond-anvil pressure cell, the infrared spectra of oxalic acid, polyvinyl alcohol, nylon 6-6, and a number of other materials at various pressures up to 25,000 atm were obtained. Studies on two of the pressure-induced changes—(1) the shift to lower frequencies of the hydrogen-bonded-OH and -NH stretching bands, and (2) the intensity changes of the two $-CH_2$ stretching bands—are reported. Author

N64-29382 MHD Research, Inc., Newport Beach, Calif.
HIGH POWER LASER PHYSICS. PART A: ON THE PHYSICAL THEORY OF LIQUID LASERS. PART B: NUCLEAR PUMPING OF SEMICONDUCTOR LASERS Final Report
Francis H. Webb, Jr., Paul Thiene, Paul Levine, and Joseph Eerkens (Terra Nova, Inc.) Nov. 1963 162 p ref
(Contract Nonr-4124(00); Proj. Defender)
(MHD-645; AD-423718)

A theoretical investigation was made of two possible high-power laser concepts—one, an investigation of liquid lasers, and the other, an investigation of the nuclear pumping of semiconductors. Both gain and loss processes in liquid lasers were considered. These include stimulated emission and losses due to refraction, absorption, scattering, and refraction. Two rare-earth doped halide systems were investigated. One system considered employs $AsCl_3(UCl_3)$; here an optimum threshold power of $Q = 3.77$ w/cm^3 was computed, whereas for an $AsCl_3(NdCl_3)$ system, an optimum threshold power of $Q = 1,280$ w/cm^3 was determined. The output wavelength should be $\lambda = 2.46\mu$ using uranium, and $\lambda = 1.06\mu$ for neodynium. It appears possible, on the basis of analyses, to achieve laser action by nuclear pumping in bulk direct gap semiconductors. Bulk free-carrier threshold levels are calculated for GaAs. The effects on the threshold due to donor and acceptor levels are also included. High conversion efficiencies appear possible. The degradation of performance due to radiation damage appears to be the major uncertainty. I.v.L.

N64-29390 Philco Corp., Lansdale, Pa. Lansdale Div.
RESEARCH AND DEVELOPMENT TO OBTAIN SEMICONDUCTOR DIODES FOR ELECTRONIC TUNING Third Interim Engineering Report, 27 Dec. 1963–26 Mar. 1964
[1964] 48 p refs
(Contract NObsr-89508)
(R-182.1; AD-602027)

The purpose of this program is to conduct research and development to obtain semiconductor diodes for electronic tuning, and to furnish final engineering samples as follows: 50 samples of Device "A" (250 pf) and 25 samples of Device "B" (1,000 pf). These devices are being made by planar epitaxial silicon technology with diffusion of a heavily-doped p-type region into an n-type layer on an n+ substrate. A study of two structural changes is now essentially completed. These changes, which are the guard-ring structure and the double-epitaxial-layer structure, are both capable of lowering the electrical field at the surface, thereby improving the breakdown voltage obtained on large-area planar diodes. However, the best overall yield and the most consistent results were obtained with the ring-guard structure. Considerable effort was expended in the evaluation of processing changes to obtain the desired 200-v planar diodes. The close control of epitaxial layer thickness and the minimization of the incidence of hillocks were emphasized. To date, 5 sealed 250-pf diodes, which meet all of the electrical characteristics of the Device "A" objective, and 10 sealed 1,000-pf diodes, which meet all of the Device "B" specifications, have been fabricated. I.v.L.

N64-29401* Varian Associates, Beverly, Mass.
MEASUREMENTS AND IMPROVEMENTS OF TWO HYDROGEN MASERS Quarterly Progress Report, Mar. 1–Jun. 30, 1964
R. Vessot 20 Jul. 1964 12 p
(Contract NAS8-2604)
(NASA-CR-58644) OTS: $1.60 ph

A mounting and tuning mechanism has been built for incorporating a solid cavity into hydrogen masers. A system for phase locking a crystal oscillator to a hydrogen maser for making long-term measurements via VLF and Loran "C" is under construction. A cross-correlation technique for measuring the short term properties of stable oscillators is also presented. P.V.E.

N64-29420 Lincoln Lab., Mass. Inst. of Tech., Lexington
SOLID STATE RESEARCH, 1964
4 Jun. 1964 77 p refs
(Contract AF 19(628)-500)
(ESD-TDR-64-48; AD-601830)

Activities in the following areas of research are summarized: (1) solid-state device research; (2) laser research; (3) materials research; (4) band structure and spectroscopy of solids; and (5) magnetism and resonance. P.V.E.

N64-29453* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A RUTILE TRAVELING WAVE MASER
C. Curtis Johnson Washington, NASA, Sep. 1964 14 p refs
(NASA-TN-D-2490) OTS: $0.50

This paper introduces a new type of traveling wave maser in which the active material is chromium-doped rutile (TiO_2) and the slow wave structure is a meander line. The basic components of a maser, that is, the active material, the slow wave circuit, and the reverse isolation requirements, are discussed. This device has a 10° K noise temperature. Data are presented on the gain realizable over a 250-mc tunable bandwidth. Author

N64-29544 California U., La Jolla
SPONTANEOUS MAGNETIZATION IN IDEALIZED FERROMAGNETS
Robert B. Griffiths 28 Apr. 1964 29 p refs
(Contract Nonr-2216-(11))
(TR-19; AD-601858) OTS: $0.75

An attempt, not entirely successful, is made to clarify the relation between two definitions of spontaneous magnetization in a Heisenberg or Ising ferromagnet with short-range interaction. One definition uses the average magnetization in the presence of an external magnetic field; the other uses the probability distribution of the magnetization in the absence of a field. In connection with the latter, the analog for magnetic systems of the monotone pressure–volume relation in a gas (computed in the canonical ensemble) is demonstrated. The analysis requires that the total z component of magnetization commutes with the Hamiltonian. Author

N64-29554 California U., Riverside
THEORY OF SCATTERING IN SOLIDS
Joseph Callaway [1963] 53 p refs
(Grant AF-AFOSR-62-318)
(TR-2; AD-438130) OTS: $5.60

The general theory of the scattering of excitations in solids by localized imperfections is discussed. The solid-state analog of the usual partial wave expansion of the scattering amplitude is derived. The applicability of the general theory to phonons and spin waves as well as electrons is demonstrated. Author

N64-29613 Weizmann Inst. of Science, Rehovoth (Israel)
THE SECOND ORDER SUSCEPTIBILITY TERMS IN ORTHOFERRITES AT ROOM TEMPERATURE
G. Gorodetsky and D. Treves 15 Sep. 1963 16 p refs
(Contract AF 61(052)-654)
(TN-2; AD-602470) OTS: $1.00

Two possible mechanisms for weak ferromagnetism—single-ion magnetocrystalline anisotropy and antisymmetric exchange—are examined on orthoferrites that contain a paramagnetic rare earth. The study was done by comparing the ferromagnetic components and the terms of the second-order susceptibility tensor that are obtained from torque measurements to the equivalent values calculated from Hamiltonians based on above mechanisms. The results show that the weak ferromagnetism is due mainly to the antisymmetric exchange mechanism. Author

N64-29616 Weizmann Inst. of Science, Rehovoth (Israel)
ORDERED MAGNETISM IN SOLIDS Annual Summary Report
S. Shtrikman and D. Treves 1 Jan. 1963 11 p refs
(Contract AF 61(052)-654)
(TN-3; AD-602640)

The current program status includes the following: (1) Two automatic recording instruments for static magnetic measurements were completed—a torquemeter and a vibrating sample magnetometer. These instruments have been used to measure the magnetic properties of some 10 rare-earth orthoferrites in single-crystal form. Results of measurements show that the mechanism responsible for weak ferromagnetism in these orthoferrites is the antisymmetric exchange interaction. As for liquid helium, magnetization tests have been made of a superconducting magnet capable of producing 50-k gauss. This magnet will be used in conjunction with the magnetization measurement of orthoferrites by the axial extraction method. (2) One supergenerative spectrometer is in operation in the range that covers the Fe^{+3} internal field. (3) A pulsed field unit is under construction for providing external fields in the 100-k gauss range, as required in particular crystallographic orientations. (4) An automatic recording constant-velocity Mossbauer spectrometer was developed and used to study the hyperfine field on 14 different orthoferrites at room and liquid air temperatures. Results of the study show that the sublattice magnetization follows the spin 5/2 Brillouin function. I.v.L.

N64-29617 Weizmann Inst. of Science, Rehovoth (Israel)
ON THE CURIE TEMPERATURE OF Λ-FE_2O_3
P. Gilad, M. Greenshpan, P. Hillman, and H. Shechter 20 Nov. 1963 6 p refs
(Contract AF 61(052)-621)
(TN-3; AD-602466) OTS: $1.00

Conflicting results on the Neel temperature of $-Fe_2O_3$ made it necessary to recheck results by means of more accurate instruments. This resulted in a temperature of (682 ± 10)° C, which was essentially the same as the authors' previous measurements. Author

N64-29625 Dynatech Corp., Cambridge, Mass.
INVESTIGATION OF ELECTROMAGNETIC AND THERMAL EFFECTS IN SUPERCONDUCTING GENERATORS First Quarterly Report
H. W. Mooncai, R. L. Mela, R. Hancox, E. F. Doyle, M. Hurwitz et al Jul. 1964 28 p refs
(Contract AF 33(615)-1574)
(DYNATECH-485; AD-602748) OTS: $2.00

The work consisted primarily of designing experiments. Considerable thought was devoted to the difficult problem of measuring heat generation in superconductors under swept field conditions. Tests to measure thermal effects due to the leads that carry current from the cryogenic to the ambient region are described; the apparatus to perform these tests has been constructed, and shakedown testing is underway. The designs of tests to demonstrate electrical output characteristics of and magnetic effects in superconductor stators are described. Author

N64-29641 International Business Machines Corp., Yorktown Heights, N.Y. Watson Research Center
GaAs LASER MATERIALS STUDY Second Semiannual Technical Summary Report, 1 Jan.–31 May 1964
W. J. Turner and H. Rupprecht [1964] 33 p refs
(Contract Nonr-4136(00); Proj. Defender)
(AD-442598)

In a previous report, observations of crystal defects such as laminar distribution of impurities perpendicular to the growth direction were discussed. In this report, further evidence of these striations from infrared transmission microscopy is presented. The origin of the striae in Czochralski pulled crystals was traced to the uneven motion of the seed holder as a consequence of the magnetic pulling mechanism. In support of the goal of higher power, higher temperature operation, a study of the temperature dependence of laser parameters such as gain per unit length, loss per unit length, and threshold current density was undertaken, and the results are presented. The advantages for ultimate device objectives of different fabrication techniques such as traveling solvent growth, and combined vapor growth and diffusion techniques for p-n° -n structures are explored. Author

N64-29643 Texas Instruments, Inc., Dallas
MATERIAL PROCESSING AND PHENOMENA INVESTIGATION OF FUNCTIONAL ELECTRONIC BLOCKS
Rowland E. Johnson Wright-Patterson AFB, Ohio, AF Avionics Lab., Jul. 1964 182 p refs
(Contract AF 33(657)-9196)
(AL-TDR-64-135; AD-602482) OTS: $6.00

A system was developed for depositing epitaxial silicon on GaAs substrates. For control of the deposit, an electron beam evaporator was modified for use on this project. Miscellaneous contamination sources caused impurities in the deposits that were made. GaAs was prepared epitaxially by three reactions: (1) Ga + As in the presence of HCl and H_2; (2) GaAs carried by $AsCl_3$ and H_2; and (3) Ga + $AsCl_3$ in the presence of H_2. Evaporated resistors and capacitors were prepared by standard techniques on the surface of GaAs. A new and improved system of diffusion (from doped SiO_2 films) into GaAs was discovered and developed. Diffusion of zinc by this method was studied in great detail. The SiO_2 film protects the GaAs surface during diffusion and provides a dopant source as well. Author

N64-29653 Sperry Microwave Electronics Co., Clearwater, Fla.
INVESTIGATION OF LARGE SIGNAL MICROWAVE EFFECTS IN FERROELECTRIC MATERIALS Quarterly Report, 1 Jan.–31 Mar. 1964
G. A. Burdick and T. J. Lyon Apr. 1964 59 p refs
(Contract DA-36-039-AMC-03240(E))
(QR-3; AD-602508)

Theory and techniques are discussed, and experimental results are reported, for measurements on selected ferroelectrics of interest in this program. The measurements include: (1) insertion loss and phase shift as a function of biasing voltage at 35 Gc; (2) insertion loss and phase shift as a function of sample temperature at 35 Gc; (3) dielectric constant as a function of sample temperature at 0.5, 1, and 2 kc; and (4) quarter-wave transformer applications. The ferroelectrics studied include series of barium–strontium titanates, barium–strontium–nickel titanates and lead–strontium titanates, and single-crystal triglycine sulfate. Author

N64-29655 California U., Livermore Lawrence Radiation Lab.
HOLMIUM, A BIBLIOGRAPHY 1955 TO APRIL 1964
Carl J. Wensrich [1964] 37 p refs
(Contract W-7405-ENG-48)
(UCRL-7719) OTS: $0.75

N64-29677 Carnegie Inst. of Tech., Pittsburgh, Pa.
THE LOW TEMPERATURE MAGNETIC SUSCEPTIBILITY OF $Mn(HCO_2)_2 \cdot 2H_2O$
A. Foner Cohen, S. A. Friedberg, and G. R. Wagner 22 Jun. 1964 7 p
(Contract Nonr-760(05))
(TR-23; AD-602520) OTS: $1.00

Manganese formate was prepared by reacting reagent grade $MnCO_3$ and HCOOH. Monoclinic single crystals of the dihydrate were grown from saturated aqueous solution at room temperature. The susceptibilities of several crystals were measured by a mutual inductance technique at 275 cps, with consistent results. Preliminary heat-capacity measurements on $Mn(HCO_2)_2 \cdot 2H_2O$ indicate the presence of cooperative anomalies at 1.7° K and 3.7° K, supporting the conclusion that rather abrupt changes in the degree of long-range spin order occur at these low temperatures. There is no alteration to earlier conclusions that χ powder obeys a Curie–Weiss law between 0.5° K and 1.5° K. Only below ~ 0.1° K will long-range order be extended to three dimensions through the participation of type 2 Mn^{++}. A.W.

N64-29681 Linde Co., Indianapolis, Ind. Speedway Labs.
SYMMETRICAL LASER CRYSTALS Annual Summary Report, 1 May 1963–30 Apr. 1964
O. H. Nestor 25 Jun. 1964 32 p refs
(Contract Nonr-4131(00); ARPA Order-306-62; Proj. Defender)
(AD-442555)

The objectives of this program are to grow cm^3-size crystals of cubic perovskites activated with divalent or tetravalent dopant cations, which will substitute directly without charge compensation, and to determine the fluorescence characteristics of these materials. Perovskites of primary and secondary interest are $BaZrO_3$ and $SrTiO_3$, respectively. Cations of interest include divalent and tetravalent rare earths and Mn^{+4}. Several growth techniques were utilized, focusing on $BaZrO_3$ and $SrTiO_3$ but also including $BaTiO_3$, $BaSnO_3$, $SrSnO_3$, and $SrZrO_3$. Crystalline $BaZrO_3$ samples, both Sm-doped and undoped, were recovered from solidified melts. Short- and long-lived visible fluorescence was observed in the specimens, but have not been delineated as yet. Large crystals of $SrTiO_3$:Mn^{+4} were grown. Their quality appears to be fair. Submillimeter-size crystals of cubic $BaZrO_3$ and orthorhombic $SrZrO_3$ were grown by a flux technique, and millimeter-size crystals of CeO_2 were grown from a flux solution. I.v.L.

N64-29690* Denver U., Colo. Denver Research Inst.
THEORETICAL STUDIES ON THE RELATIONSHIPS BETWEEN THE THERMIONIC WORK FUNCTION OF REFRACTORY INTERMETALLIC COMPOUNDS AND THEIR ELECTRONIC AND CRYSTAL STRUCTURES Progress Report, 1 Jan.–31 Jun. 1964
C. Samuel Miller and Jerry D. Plunkett 25 Jul. 1964 3 p refs
(Grant NsG-365)
(NASA-CR-58564) OTS: $1.10 ph

Fabrication of diode and emissivity specimens of the five intermetallic compounds formed by group VI-A metals and rhenium is proceeding. The technique being used is the electrophoretic deposition of the finely ground materials on a refractory-metal substrate. Attempts are being made to eliminate contamination of the finely ground particles of iron from the grinding process. Major effort was concentrated on the design and construction of a high-voltage pulse generator and a high-temperature vacuum furnace needed to obtain accurate temperatures are measured with an optical pyrometer. M.P.G.

N64-29697* Varian Associates, Beverly, Mass.
THE DEVELOPMENT AND CONSTRUCTION OF TWO HYDROGEN MASERS Interim Technical Report, 1 Feb. 1962–31 May 1963
R. Vessot et al 30 Jun. 1964 100 p refs
(Contract NAS8-2604)
(NASA-CR-58542) OTS: $8.60

The design and development of the various components of the hydrogen maser are described. These include the following: the frame and vacuum manifold, the hydrogen purifier and flow control, the hydrogen discharge dissociator, the magnetic hexapole state selector, the storage bulb, the RF cavity, and magnetic shielding and field controls. In addition, data are reported from measurements of the relative stability of the two state-of-the-art hydrogen masers, as well as their stability as measured via external communications. A report on the frequency of hydrogen is presented as an appendix. I.v.L.

N64-29747 Sheffield U. (Gt. Brit.)
NUCLEAR MAGNETIC RESONANCE IN FERROMAGNETIC AND ANTIFERROMAGNETIC ALLOYS Final Technical Report, Jun. 1, 1963–May 31, 1964
[1964] 22 p refs
(Contract DA-91-591-EUC-2907)
(AD-602514) OTS: $1.00

This report concerns the initial stages of investigations into nuclear magnetic resonance in ferromagnetic materials. The resonances are observed in zero applied magnetic field, so that the experiments result in a value for the effective magnetic field at the nucleus. The types of apparatus used to observe nuclear magnetic resonance are briefly reviewed, together with the reasons for selecting a VHF variable frequency, frequency modulated marginal oscillator. The marginal oscillators constructed are described, together with their limitations. A table of other reported nuclear magnetic resonances in ferromagnetic materials is given, and it is shown empirically that for materials of large magnetic moment the resonant frequency is likely to be high. Author

N64-29812 Stanford U., Calif.
REFLECTION AND TRANSMISSION BY LAYERED CRYSTAL STRUCTURES
Harold Levine 30 Jul. 1964 28 p refs
(Contract Nonr-225(74))
(TR-2; AD-604177)

A basis is presented for describing both the state of affairs within the regular structure of a crystal and the external measures of reflection and transmission. The entire wave functions are regarded as an embodiment of the requisite (and sought after) aspects of the scattering problem, and thus recurrences are dispensed with. On explicit realization of the freely traveling-wave forms that display the modulated character appropriate to their progression through a periodic array of scattering planes, the analysis proceeds, as in the corresponding problems of reflection from, and transmission through homogeneous regions with parallel boundaries; that is, only the compatibility of the internal and external wave functions on these boundaries needs to be obtained. I.v.L.

N64-29820 Georgia Inst. of Tech., Atlanta Engineering Experiment Station
QUARTZ CRYSTAL AGING EFFECTS Quarterly Report, 15 Feb.–15 May 1964
R. B. Belser and W. H. Hicklin 15 May 1964 53 p refs
(Contract DA-36-039-AMC-02251(E))
(QR-5; AD-604269)

The purposes of this research are to reduce the frequency-aging of quartz resonators with respect to time, to reduce the failure rate, and to increase the reliability of the resonators. The current status includes the following: (1) The aging rates of precision 3-mc resonators of natural, swept, cultured, and swept-cultured quartz varied with the type of quartz. Aging rates ranged from 1 to 9 pp 10^8/wk, initially, but decreased to 0.2 to 3 pp 10^8/wk after 20 weeks. (2) Sixteen-mc resonators irradiated at 10^4 rads of gamma + 9×10^{13} nvt, or exposed to a Cs-137 gamma source (10^4 rads of gamma), exhibited shifts in frequency of a few parts in 10^7. Aging rates after a few days, subsequent to irradiation, were changed little for 90% of the units. (3) The X-ray source image-distortion patterns were made of typical and atypical aging behavior in the cases of low-frequency and 10-mc resonators. Examples of scratches, twinning, strain, and other internal defects were exhibited. I.v.L.

N64-29835 Calif. Inst. of Tech., Pasadena Quantum Electronics Lab.
LASER ELECTROMAGNETICS Final Report
Nicholas George 1 Jul. 1964 16 p refs
(Contract AF 19(604)-8052)
(AFCRL-64-538; AD-604728)

This program of research in laser electromagnetics includes research into the generation, propagation, and detection of very-high-frequency (optical) coherent electromagnetic radiation. Abstracts of the following reports are included in this report: Light Scattering from Dielectric Film Laser Mirrors, Modified Fabry–Perot Interferometer, Multireflector Optical Resonators, Interferometric Measurement of Index of Refraction, and Plasma Diagnosis by Means of Photon–Electron Scattering. Author

N64-29856 Naval Ordnance Lab., Corona, Calif. Research Dept.
PYROELECTRIC SENSITIVITY OF TRIGLYCINE SULFATE DETECTORS
D. J. White 1 Jul. 1964 25 p refs
(NOLC-601; AD-602729)

Expressions are derived for the theoretical pyroelectric current sensitivity of triglycine sulfate in response to chopped or modulated electromagnetic radiation. Sinusoidal chopping, amplitude modulation, square wave modulation, pulses, and

step functions of the radiation are considered. These expressions are compared with the experimental results achieved with various pyroelectric detectors. The sensitivity achieved varies from a fraction of a percent to approximately 100 percent of the theoretical values. Author

N64-29861 Keystone Controls Corp., Newark, N.J.
5 mc SINGLE SIDEBAND CRYSTALS Third Quarterly Progress Report, Jan.–Mar. 1964
Raymond F. Woolley 25 Mar. 1963 26 p
(Contract DA-36-039-AMC-03307(E))
(Rept.-3; AD-603185)

This project is intended to develop a noncontrolled crystal having a precision of frequency in the order of 5 pp 10^6, a stability of 1 pp 10^8 per week, or better, and a Q in excess of 500,000. Equipment modifications were made, and several aging tests were performed on gold-plated units. The various aging test attempts are reviewed, and problems are discussed. Author

N64-29873 Stanford U., Calif. Microwave Lab.
ON SHARP OPTICAL TRANSITIONS IN CRYSTALS—EFFECTS OF STATIC AND DYNAMIC PERTURBATIONS Interim Technical Report
G. F. Imbusch Jul. 1964 161 p refs
(Contract DA-31-124-ARO-D-208)
(ML-1190; AD-604659)

This investigation is concerned with the effects of some perturbations on the sharp optical lines emitted by chromium and vanadium ions in MgO. Because the atomic states of the impurity ion are dependent on the lattice environment, it is possible to modify the radiation from such impurity ions by perturbing the host crystal. The following effects are investigated: (1) the effect of the perturbations caused by lattice vibrations (phonons) on the radiation, and (2) the effects of static perturbations (pressure, magnetic fields, and electric fields) on the optical transitions. Author

N64-29874 Naval Research Lab., Washington, D.C. Microwave Antennas and Components Branch
A STUDY OF A FERRITE PHASE SHIFTER
M. L. Reuss, Jr. 8 Jun. 1964 10 p
(NRL-6112)

A study of a DOFL-type phase shifter was conducted at S-band. This phase shifter was capable of operation at power levels above 10-kw peak power. Phase shift and loss were determined as a function of several parameters—ferrite width and height, waveguide height, and presence or absence of dielectric. The dielectric was used to permit use of this geometry at high power levels, where it served as a heat-transfer medium between the axially located ferrite slab and the top and bottom waveguide walls. High power measurements consisted of measuring loss as a function of power level. At low power levels, for a given width of ferrite, much more phase shift can be obtained if the ferrite only partially fills the waveguide in height, but when the height gap is filled with dielectric as required at high power levels, at most a 20% improvement can be obtained over ferrite filling the entire height. Author

N64-29878 Battelle Memorial Inst., Columbus, Ohio Radiation Effects Information Center
RADIATION EFFECTS. STATE OF THE ART 1963–1964
D. J. Hamman, E. N. Wyler, R. K. Thatcher, W. H. Veazie, Jr., F. R. Shober et al 30 Jun. 1964 114 p refs
(Contract AF 33(615)-1124)
(REIC-34; AD-603708)

Reports received at the Radiation Effects Information Center during the 1963–1964 period are analyzed to determine the current state-of-the-art in the following areas: (1) electronics, particularly in the semiconductor field; (2) polymeric materials, most of which were studied in the total space environment, with polyimide and phosphonitrillic chloride polymers reported as having better radiation stability than presently used polymers; (3) lubricants, flotation, and hydraulic fluids; (4) ceramics; (5) space-radiation environment; (6) dosimetry; and (7) structural metals and alloys. A general approximation of the current status of materials development for use in various radiation environment is presented graphically. M.P.G.

N64-29893 Stanford U., Calif. Solid-State Electronics Lab.
DEFECT STRUCTURES IN QUENCHED AND ANNEALED GaAs CRYSTALS Technical Report No. 5106-1
G. L. Pearson, H. R. Potts, and V. G. Macres Jun. 1964 18 p refs
(Contract DA-31-124-ARO-D-155)
(SEL-64-069; AD-602801)

Lattice parameter measurements have been made by the Kossel-line technique on quenched gallium arsenide crystals. Samples quenched from temperatures above 1,000° C showed an increase in lattice parameter. The change with temperature has an enthalpy of 2.0 ev, and is attributed to the formation of vacancies. Room-temperature annealing of the defects is also shown, and is seen to proceed in several stages. Author

N64-29905 Mithras, Inc., Cambridge, Mass.
TABULATION OF FIRST ORDER MAGNETIC PHASE TRANSITIONS Scientific Report No. 3
Charles S. Naiman and Robert Gilmore Oct. 1963 24 p refs
(Contract AF 19(628)-2395)
(MC-62-49-R3; AFCRL-64-464; AD-604424)

A literature search has been carried out and a tabulation has been made of all known first-order magnetic phase transitions. The table includes all substances that have been found to undergo such phase transitions, and their relevant characteristics have been studied. One kind of transition, the so-called "spin-flopping" type, exists for a very large class of materials. A definition of first-order magnetic phase transitions is formulated in terms of familiar thermodynamic quantities. Some of the implications of this definition are discussed. An example of a first-order magnetic phase transition is discussed (AF→AF spin flop), and characterized by three parameters—anisotropy energy, and parallel and perpendicular susceptibilities. Author

N64-29911 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
RECENT DEVELOPMENTS IN PHOTOELASTICITY
A. Pirard 10 Aug. 1964 20 p Transl. into ENGLISH from La Métallurgie (France), 79, 1947 p 17–21
(RSIC-240; AD-604602)

In photoelastic methods, the problem caused by the equipment is that of obtaining a parallel field of light linearly polarized for the isoclinics and circularly polarized for the isochromatics. Polaroid filters solve this problem when used with one-wave, half-wave, and quarter-wave plates for any desired wavelength and any apparatus. The paper describes experiments in the field of photoelasticity, conducted at Liège University with this apparatus. A.W.

N64-29929 Ohio State U. Research Foundation, Columbus
INVESTIGATION OF NEW SEMICONDUCTOR PHENOMENON
K. K. Knaell and M. O. Thurston Wright-Patterson AFB, Ohio, AMRL, Jun. 1964 53 p refs
(Contract AF 33(606)-8384)
(AMRL-TDR-63-117; AD-604419)

During a routine investigation of transistor behavior certain silicon-grown junction transistors were discovered that manifested unusually high short circuit current gains, h_{fe}. The present investigation was made to determine the basic nature of this h_{fe} and to develop an h_{fe} transistor. Following several unsuccessful attempts at producing devices designed to display h_{fe}, further measurements were made on already existing transistors. These measurements led to several observations unexplainable in the light of the original model; therefore, additional measurements were performed. These measurements gave more insight into the transistor and explained some of the characteristics of its behavior in terms of its high h_{fe}. Attention was then concentrated on the physical structure of the transistor, and experiments were performed to alter the structure in an attempt to learn the mechanism causing high h_{fe}. Author

N64-29952 Istituto Universitario Navale, Naples (Italy)
MATCHING AND ABSORBING E.M. MATERIALS Annual Summary Report Number 2, 1 Feb. 1963–31 Jan. 1964
G. Latmiral, G. Franceschetti, and R. Vinciguerra 20 Feb. 1963 16 p refs
(Contract AF 61(052)-589)
(ASR-4; AD-602472)

The results of a theoretical and experimental research on layered, or geometrically tapered, matching or absorbing materials are discussed. For obtaining materials having prescribed em constants, artificial dielectrics (of the obstacle or mixture type) can be used. Simple matching or absorbing devices can be realized by means of conical-obstacle or hole-type artificial dielectrics. Author

N64-29967 General Electric Co., Utica, N.Y. Light Military Electronics Dept.
FAILURE MECHANISMS AT SURFACES AND INTERFACES Third Interim Technical Documentary Report, 1 Jan.–1 Apr. 1964
K. K. Reinhartz, V. A. Russell, B. L. Stockman, W. J. van der Grinten, and W. L. Willis Griffiss AFB, N.Y., RADC, Jul. 1964 51 p refs
(Contract AF 30(602)-3085)
(RADC-TDR-64-197; AD-604349)

Certain fabrication details, relevant to the condition of the CdS-SiO interface, have been found to greatly influence the stress sensitivity of thin-film field-effect devices. An exploratory study of the incipient dielectric degradation of code 8871 glass capacitor dielectrics, using thin-film field-effect sensors, has been initiated. Theoretical considerations concerning the migration of sodium and other ions in glass support the soundness of this approach. The mounting of such sensors on 8871 glass ribbon has been achieved, and initial measurements are encouraging. Author

N64-29984 Research Triangle Inst., Durham, N.C.
INTEGRATED SILICON DEVICE TECHNOLOGY. VOLUME III: PHOTOENGRAVING Technical Documentary Report, Aug.–Nov. 1963
Jan. 1964 72 p refs
(Contract AF 33(657)-10340)
(ASD-TDR-63-316, Vol. III; AD-603715)

The various types of photoresists and photosensitive coatings are described along with their known properties. Step-by-step procedures are included for the use of these resists. A general evaluation of the photoengraving process and its limits is included. Author

N64-29987 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
FOURTH INTERCOLLEGIATE CONFERENCE ON BREAKDOWN OF DIELECTRICS AND SEMICONDUCTORS
V. T. Renne 9 Jul. 1964 5 p refs Transl. into ENGLISH from Elektrichestvo (Moscow), no. 7, 1963 p 94–95
(FTD-TT-64-546/1; AD-603457)

During sessions of five separate sections held in the Soviet Union on the general topic of breakdown of dielectrics and semiconductors, progress was noted primarily in the study of their electrical strength and in improvement in the quality of electrical insulation and articles of semiconductor technology. A.W.

N64-29993 Air Force Cambridge Research Labs., Bedford, Mass. Solid State Sciences Lab.
FERRIMAGNETIC RESONANCE RELATIONS FOR MAGNETO-CRYSTALLINE ANISOTROPY IN CUBIC CRYSTALS
Hans Roland Zapp (M.S. Thesis–MIT) Apr. 1964 110 p refs
Its Spec. Rept. no. 2
(AFCRL-64-72; AD-603593)

A general resonance equation, which directly relates the resonance frequency to the static applied field and internal anisotropy field for cubic ferrimagnets, has been derived. The equation is valid for an infinite number of planes that contain the <110> direction. The limitations and difficulties of other approaches outlined in the literature are mentioned. The advantages and disadvantages of the derivation contained in this thesis are explained. Certain interesting features of the resonance relationship are mentioned. The theoretical calculations give very close agreement to the experimental observations on yttrium iron garnet (YIG), as well as gallium- and indium-substituted YIG's. The theoretical calculations, however, increasingly deviate from experimental results as the internal anisotropy fields increase. Author

N64-30002 Mithras, Inc., Cambridge, Mass.
MEASUREMENT OF THE SPIN-FLOPPING RELAXATION TIME IN $CuCl_2 \cdot 2H_2O$ Scientific Report No. 2
Charles S. Naiman and Thomas R. Lawrence Jan. 1964 19 p refs
(Contract AF 19(628)-2395)
(MC-62-49-R2; AFCRL-64-456; AD-604425)

The relaxation time associated with the spin-flopping transition in $CuCl_2 \cdot 2H_2O$ has been measured by an RF susceptibility technique and found to be $(0.70 \pm 0.15) \times 10^{-7}$ seconds at 2.4° K. This is the first such measurement on an order-order transition. Preliminary measurements also yield the temperature dependence of the critical field, H_c, in good agreement with previous data. Some otherwise strange observations have been qualitatively explained by a temperature rise due to the dissipation of energy in the crystal through the resistive component of the critical field susceptibility. These effects become more pronounced with increasing power, which is consistent with their being of thermal origin. Author

N64-30006 Clevite Corp., Palo Alto, Calif. Shockley Research Lab.
RESEARCH ON THE INFLUENCE OF SURFACE CONDITIONS ON DIFFUSION IN SILICON Final Report, Jun. 16, 1961–Jun. 15, 1964
Reinhard K. Gereth et al Jul. 1964 163 p refs
(Contract DA-04-200-ORD-1166(X))
(AROD-3330-4; AD-604660)

Ion bombardment and simultaneous doping of silicon have been successfully achieved by means of a d.c. glow discharge. Under these conditions, impurity diffusion was found to be enhanced by factors up to 10^5 over thermal diffusion. This effect can be explained quantitatively with the assumption of lattice defects, probably vacancies, which are created by the ion bombardment and diffuse into the silicon. The p-type layers were observed when n-type silicon was bombarded in a glow discharge of hydrogen with phosphine admixture at temperature below 700° C. These layers may be caused by acceptor-like defects. The experimental data of Tannenbaum for the strongly concentration dependent diffusion coefficient of phosphorus in silicon have been analyzed. This coefficient was found to follow a high-order dependence of the concentration of phosphorus, at least as high as the third power of the concentration.
Author

N64-30014 Martin Co., Orlando, Fla.
EXCITATION AND DETECTION TECHNIQUES FOR MILLIMETER WAVE TRANSITIONS Seventh Quarterly Progress Report, 1 Jan.–1 Apr. 1964
J. J. Gallagher, R. G. Strauch, and R. E. Cupp Jun. 1964 42 p refs
(Contract DA-36-039-SC-90753)
(OR-3959; AD-601918)

In this quarter, electric resonance experiments have been performed on hydrogen sulfide at 168.7 and 216.4 Gc. Low-frequency resonances have been observed between Stark components of rotational states. In addition, line-width measurements being performed in a molecular beam absorption cell are described.
Author

N64-30028 Weizmann Inst. of Science, Rehovoth (Israel)
DTA AND MOSSBAUER STUDIES IN RARE EARTH ORTHOFERRITES
M. Eibschutz, G. Gorodetsky, S. Shtrikman, and D. Treves 27 Oct. 1963 9 p refs
(Contract AF 61(052)-654)
(TN-3; AD-602469) OTS: $1.00

Curie temperatures of 14 different orthoferrites with the chemical formula $RFeO_3$, (R = Y, La, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu) were measured by differential thermal analysis. Hyperfine interactions of the Fe^{57} nucleus in the same materials were determined from their Mössbauer spectra. It is found that the quadrupole splitting, with the exception of the case of Sm, isomer shift, Curie temperature, and internal field vary regularly with the ionic size of R.
Author

N64-30031 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
IDENTITY PERIOD OF THE LATTICE AND MICROHARDNESS OF SOLID SOLUTIONS OF INDIUM AND GALLIUM PHOSPHIDES
N. N. Sirota and V. V. Rosov 11 Jun. 1964 6 p Transl. into ENGLISH from Dokl. Akad. Nauk Belorussk. SSR (Moscow), v. 7, no. 7, 1963 p 446–448
(FTD-TT-64-151/1+2; AD-602311) OTS: $1.00

Phosphides of indium and gallium belong to the ground of semiconductor compounds $A^{III}B^{V}$. This investigation clarifies the matter of the existence of solid solutions in the quasi-binary system InP-GaP, and determines the identity period of the crystalline lattice. Indium phosphide and alloys containing less than 30% of GaP were almost completely synthesized. Some 15 fusions were synthesized. These were subjected to metallographic and radiographic analyses, and their microhardness was measured. A lattice constant up to 0.01 A was determined.
A.W.

N64-30034 Atomics International, Canoga Park, Calif.
THE AGE OF FISSION NEUTRONS TO INDIUM RESONANCE ENERGY IN ZIRCONIUM-WATER MIXTURES
R. K. Paschall 15 Sep. 1964 46 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-9503) OTS: $1.25

The age of fission neutrons to indium resonance energy (1.46 ev) was measured in mixtures of zirconium and water. Three different volume ratios of metal-to-water were investigated. The experimental technique of a finite plane fission source with essentially infinite plane detectors was used (which was equivalent to using an infinite plane source with axial detectors). Thus, the theoretical corrections to the measured results were only 1.5% or less. This is the same technique used previously to measure the age in pure water, and comparisons were made with those data. The results indicate a linear variation of the age as a function of metal-to-water ratio. From these experiments, $\tau(cm^2) = 26.63 + 19.23R$ for $0.00 \leq R \leq 1.20$, where R is the metal-to-water volume ratio.
Author

N64-30043 Weizmann Inst. of Science, Rehovoth (Israel)
MAGNETIC PROPERTIES USING THE MOSSBAUER EFFECT Summary Report No. 1, 1 May 1962–30 Apr. 1963
P. Hillman [1963] 22 p
(Contract AF 61(052)-621)
(AD-602465) OTS: $1.00

Résumés of the following magnetic properties studies using Mössbauer apparatus are presented: (1) the Curie temperature of α-Fe_2O_3; (2) the nature and high-temperature behavior of FeO; (3) barium ferrite measurements; (4) superparamagnetism; and (5) krypton and the clathrates.
M.P.G.

N64-30051 Weizmann Inst. of Science, Rehovoth (Israel)
MAGNETIC SYMMETRY AND ELECTRON NUCLEUS-INTERACTIONS IN MAGNETIC CRYSTALS
S. Shtrikman and D. Treves 16 Feb. 1963 6 p refs
(Contract AF 61(052)-654)
(TN-1; AD-602471) OTS: $1.00

These studies report effects in magnetic crystals that are variant under time reversal. It can be said that from the knowledge of the site symmetry, the form can be predicted of the various interaction tensors in the following equations:

$$H^e_i = H^e_i(0) + t_{ij}H_j + r_{ij}E_j + S_{ijk}e_{jk} + \ldots . \text{ (a)}; \quad V_{ij} = V_{ij}(0) + T_{ijk}H_k + H_{ijk}E_k + S_{ijkl}e_{kl} + \ldots . \text{ (b)}.$$

Conversely, the experimental determination of the form of these tensors will aid in finding the magnetic site symmetry and, through it, the magnetic space group and structure of the material investigated.
A.W.

N64-30083 Stanford Research Inst., Menlo Park, Calif.
THERMOELECTRIC MATERIALS Quarterly Progress Report, 8 Jan.–8 Apr. 1964
J. W. Johnson 30 Apr. 1964 4 p ref
(Contract NObs-88487)
(QPR-4; AD-604914)

Measurements of the Seebeck coefficient and resistivity of the cuprous sulfide–lead sulfide system in the liquid state have been made for compositions containing 75, 70, 65, 60, and 25 mole percent cuprous sulfide. Preliminary results for this system indicate that Seebeck coefficient progresses smoothly from p-type at high cuprous sulfide compositions to n-type at high lead sulfide compositions, passing through zero near the eutectic composition at 61 mole percent cuprous sulfide. Similar behavior, although not quite as distinct, is exhibited by the resistivity at constant temperature. Author

N64-30105 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
METHOD OF CONTACTLESS INVESTIGATING ELECTRICAL CONDUCTION OF CADMIUM SULFIDE TYPE SEMICONDUCTORS
S. Kynev, M. Sheynkman, and V. Fursenko 20 Jul. 1964 13 p refs Transl. into ENGLISH from Izv. Fiz. Inst. s Aneb, Bulgar. Akad. Nauk. (Sofia), v. 10, no. 2, 1962 p 29–36
(FTD-TT-64-155/1+2; AD-603391)

The method described is a measuring method. It is based on the use of generator tube and dielectric losses, used to determine the relationship between the grid current on the generator tube and the dielectric losses in the measuring capacitor, which is connected in parallel to the vibrating generator. The conductivity magnitudes of the sample are used to measure the dielectric losses in the dielectric plate of the capacitor. This method was employed in an investigation of CdS monocrystals and can be used to solve a variety of problems by studying photoconduction on relatively high ohmic semiconductors. These problems relate to the following: (1) the rapid sorting of the crystal by photoconductivity, dark conductivity, and inertia of the photocurrent; (2) the investigation of the photoelectric property of a sample; (3) contact-properties studies; (4) studies of sample properties in the process of thermal treatment; and (5) investigations of the static and kinetic properties of a sample at probe illuminations a short distance from the crystal. I.v.L.

N64-30115 Tem-Pres Research, Inc., State College, Pa.
SMALL ANGLE X-RAY SCATTERING BY METASTABLE LIQUID IMMISCIBILITY IN GLASS
John A. Williams, Bert Phillips, Guy E. Rindone, and Herbert A. Mc Kinstry (Pa. State U.) 10 Jul. 1964 48 p refs
(Contract Nonr-4089(00))
(TR-4; AD-603448)

Small angle X-ray scattering measurements were made on samples of CaO-MgO-SiO_2 glass in which metastable amorphous phase separation had been induced by heat treatment. Glass rods drawn from a melt of composition 30.5% CaO, 8.0% MgO, 61.5% SiO_2 (by weight) at 1,400° C were heat treated for 1, 2, 10, and 15 hours at 825° C. X-ray scattering intensities of heat-treated and non-heat-treated samples were measured using an apparatus based on Kratky collimation geometry and equipped with a pulse height analyzer. Particle sizes were calculated from the radii of gyration, which were determined from plots of log intensity vs θ^2, according to the method of Guinier. The data show a growth with time of the dispersed spheres from 350 to 1,880 A in diameter and correspond to the growth rate for diffusion controlled growth of a sphere. Author

N64-30123 Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
RESEARCH AND DEVELOPMENT FOR SEMICONDUCTOR SURFACE CONTROL AND STABILIZATION Scientific Report No. 1
K. D. Kang, F. Lee, and H. W. Cooper 14 May 1964 99 p
(Contract AF 19(628)-3808)
(AFCRL-64-581; AD-605566)

The effects of contaminants upon beta and leakage current are discussed. Germanium planar passivation studies are also covered. Work on metal oxide semiconductors and field effect transistors is reported. Author

N64-30132 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
OXIDATION AND SURFACE ACTIVITY OF PLATINUM MONOCRYSTALLINE SPHERICAL ELECTRODES
B. Mutafchiyev 17 Jul. 1964 12 p refs Transl. into ENGLISH from Izv. (Bulgaria), v. 2, 1962 p 93–100
(FTD-TT-64-156/1+2; AD-603325)

An investigation was made of the activity of various crystallographic zones on a platinum monocrystalline spherical cathode. The effect of the platinum-surface oxide layer upon the kinetics of electrolytic deposition on the active surface of platinum is explained. A.W.

N64-30143 Isomet Corp., Palisades Park, N.J.
CRYSTALS FOR OPTICAL MASER APPLICATIONS Final Report, 1 Jul. 1962–30 Jun. 1963
[1963] 25 p
(Contract DA-36-039-SC-90876)
(AD-438422)

A variety of laser materials including ruby, calcium tungstate, calcium fluoride, strontium titanate, and neodymium glass doped with various rare earths were successfully fabricated into laser rods of various configurations. Author

N64-30150 General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science
GAS-SOLID INTERACTIONS AT ELECTRODE SURFACES Final Report, 30 Aug. 1961–20 Mar. 1964
H. Saltsburg and D. P. Snowden 20 Mar. 1964 73 p refs
(Contract DA-44-009-ENG-4832; ARPA Order-223-617)
(GA-5099; AD-438817)

A study has been made of the frequency-dependent conductivity of powdered NiO, undoped and doped with Cr^{3+}, and the effects on that conductivity of pulsed gas adsorption of O_2. The frequency-dependent conductivity of undoped NiO is not representable as a simple Debye relaxation, but doping with Cr^{3+} induces a "structure" in the frequency-dependent conductivity which, over some frequency range, is of the Debye type. This dependence was shown to result from nonuniform distribution of Cr^{3+} in the solid. The pulsed adsorption of O_2 on powdered and single-crystal NiO revealed the existence of transient but long-lived conductivity decays. The mechanism of the decay origin is described and involves the concept of an adsorbed ion slowly being converted to a stable adsorbed neutral. Multiple trapping of the minority carriers is invoked

to describe the kinetics. Eventually, with continued O_2 adsorption, surface saturation occurs and another type of conductivity decay is observed, this one involving desorptive processes.
Author

N64-30159 Varian Associates, Palo Alto, Calif. Central Research Lab.
COHERENT INFRARED LASER Semi-annual Technical Summary Report No. 1, 17 Jun.–16 Dec. 1963
M.W. Muller, A. Sher, and R. Solomon [1963] 69 p refs
(Contract Nonr-4244(00); Proj. Defender)
(VARIAN-314-15; AD-428562)

This report is concerned with techniques of obtaining population inversions among vibrational energy levels of molecules, with a view to using such inversions for the generation of coherent infrared light. The basis for obtaining population inversions is the Franck–Condon principle, and the first molecule under consideration, to which most of the work so far has been devoted, is half-heavy hydrogen HD. Calculations relevant to the behavior of this molecule and to the properties of hydrogen gas discharges are reported. Theoretical work relating to other molecules is outlined. Author

N64-30170 Radio Corp. of America, Princeton, N.J. RCA Labs.
SOLID STATE LASER EXPLORATIONS Interim Engineering Report, Apr. 16–Jul. 15, 1964
J. Collard, R. C. Duncan, R. J. Pressley, F. Sterzer, T. Walsh et al Wright-Patterson AFB, Ohio, ASD, 1 Aug. 1964 34 p refs
(Contract AF 33(615)-1096)
(IER-3; AD-603133)

Several hard host materials are being investigated as room-temperature continuous-wave laser possibilities. These include yttrium aluminum garnet, lanthanum aluminate, and calcium molybdate. Stable divalent dysprosium in CaF_2 was obtained by either of two techniques—a chemical reduction or solid-state electrolysis. Laser beam patterns have been measured, and cw lasers were operated using external reflectors. The effects of static, homogeneous magnetic fields on cw $CaF_2:Dy^{2+}$ lasers were observed. Pumping lamp efficiencies were studied experimentally, and the results were found to be in good agreement with previously described calculations. Improved methods of keeping laser crystals cold during operation under high excitation conditions were developed and successfully tested. A microwave-frequency cavity modulator was operated with hexamine. The theory of the current-dependence of the junction capacitance of a p-n junction under reverse bias was developed and applied to a set of measurements on a diode made from part of a 2N1309 transistor. Author

N64-30175 Massachusetts U., Amherst Polymer Research Inst.
THE MEASUREMENT OF THE ORIENTATION RATE OF CRYSTALS IN A CRYSTALLINE POLYMER BY DYNAMIC X-RAY DIFFRACTION
H. Kawai, T. Itoh, D. A. Keedy, and R. S. Stein 22 May 1964 23 p refs
(Contract Nonr-3357(01))
(ONR-TR-69; AD-603064)

Dynamic birefringence measurements on crystalline polymers, such as polyethylene, indicate that there is a characteristic time for change in molecular orientation; this time has been ascribed to that required for crystals to change their orientation following the deformation of the polymer. An attempt to test this proposal by direct measurement of the orientation time, using X-ray diffraction methods, during the steady-state vibrational strain of the sample is reported. The apparatus and its operation are described. Samples examined after many thousands of cycles of vibration indicate that changes occur during the early stages of dynamic straining, after which there is negligible fatigue. These dynamic studies were carried out at vibration frequencies of 0.01, 1, 10, and 20 cps, at 20% static strain, and at dynamic strain amplitudes of 5% and 2.5%. At the lower vibration frequencies, there was little difference between the static and dynamic measurements, indicating that the 110 plane of the crystal can change its orientation in times shorter than the corresponding vibration periods. An increasing difference was found between the static and dynamic data at 10 and 20 cps, with a difference of 20% to 30% at 20 cps. This difference is considered to represent the expected dispersion resulting from a crystal orientation time of the order of 0.1 sec, in qualitative agreement with birefringence results. M.P.G.

N64-30177 Army Cold Regions Research and Engineering Lab., Hanover, N.H.
REFLECTION AND TRANSMISSION COEFFICIENTS AT THE INTERFACE ICE-SOLID
Hans Roethlisberger May 1964 22 p ref
(CRREL-110; AD-602414)

A Bendix G-15D computer program was developed to produce a table of reflection and transmission coefficients for any combination of solids for angles of emergence from 90° to 0° at any desired increment. Nafe's equations were used to obtain values for the case of ice in contact with another solid at a plane interface. Values of P and S waves were computed for 30 different cases of the second solid, which represent the major groups of rocks and compacted frozen or unfrozen soils likely to occur under glaciers. A compressional velocity of 3.6 km/sec, a density of 0.9 g/cm^3, and a value of 1/3 for Poisson's ratio were assumed for the ice. For the other solid, the velocity ranged from 1.2 to 6.0 km/sec, the density from 1.5 to 3.0 g/cm^3, and Poisson's ratio from 0 to 1/3. Author

N64-30189 Paris Observatory, Meudon (France)
THE STABILITY AND Q-FACTOR OF QUARTZ-CRYSTALS EXCITED BY THE PARALLEL FIELD TECHNIQUE Final Report, 1 Jun. 1963–31 May 1964
[1964] 31 p refs
(Contract DA-91-591-EUC-2962)
(AD-602722) OTS: $2.00

A method for determining the geometrical constants of crystals to minimize the coupling between the fundamental and unwanted modes was studied. This made it possible to set up tables giving the optimum diameters as function of the frequency, as well as other possible contours. The method was applied to 1-mc crystals of about 25-mm diameter excited by a composite field and to 1-mc crystals of about 14-mm diameter. Five-mc crystals, excited by composite and normal fields using annular electrodes, were studied. Author

N64-30196 Remington Rand Univac, St. Paul, Minn.
COMPONENT POSSIBILITIES FOR THE PREFERRED DESIGN
Jul. 1964 35 p
(Contract AF 04(694)-433)
(EF-3765-6; AD-603121) OTS: $2.00

After consideration of promising technical possibilities in silicon integrated circuits (SIC), thin film, and/or hybrid devices

offering significant advantages in a new Preferred Design Computer, the following conclusions were reached: (1) Development efforts may be better expended to facilitate input–output functions and reduction in size, weight, and power of the computer high-speed memory than on reducing the power, weight, and/or volume of the logic-arithmetic section. (2) The SIC unit package most suitable is the flat parallelopiped having ribbon leads from one or two (opposite) edges. (3) The diode transistor logic (DTL) is considered the logic current most suitable for digital functions. A.W.

N64-30197 Carnegie Inst. of Tech., Pittsburgh, Pa.
THE HEAT CAPACITY OF THE ANTIFERROMAGNET $CoCl_2 \cdot 6H_2O$ NEAR ITS NEEL POINT
J. Skalyo, Jr. and S. A. Friedberg 13 May 1964 7 p refs Submitted for Publication
(Contract Nonr-760(05))
(TR-22; AD-602519) OTS: $1.00

Measurements of heat capacity C_p of the antiferromagnetic salt, $CoCl_2 \cdot H_2O$, in the immediate neighborhood of its Néel point ($T_N \sim 2.3°$ K for H = 0) are presented in graphic form. These measurements were performed in a vacuum calorimeter of conventional design. Two specimens were studied. Specimen A consisted of 8.20 g of slices ($\sim$ 1 mm thick) cut from a large single crystal of the salt, sandwiched between Cu discs, and sealed inside a cylindrical Cu capsule together with He gas. Specimen B consisted of 54.51 gms of small crystals (average dimension $\sim$ 3 mm) filling the interstices of an egg-box grid sheet of Ag inside a cylindrical Cu capsule. Data taken on both specimens were mutually consistent. Two features of the experimental results are emphasized: (1) The method of choosing T_N resulted in the C_p exhibiting a logarithmic term whose coefficient, 0.27 R, is of the order of magnitude found in the exact theory of two-dimensional Ising antiferromagnets. (2) The logarithmic rise of the C_p appears not to continue without limit as T_N is approached. Rather, the experimental gamma anomaly is rounded off over the interval $\approx 15 \times 10^{-3}$° K about T_N. I.v.L.

N64-30205 Melpar, Inc., Falls Church, Va.
MOLECULAR CIRCUIT DEVELOPMENT Quarterly Report, 12 Mar.–12 Jun. 1964
Wilbur T. Layton [1964] 80 p refs
(Contract NOw-64-0568-d)
(QR-1; AD-602872) OTS: $3.00

The influence that annealing parameters have on the CdSe films used in field-effect devices was investigated, as were films of zinc telluride. Dielectric film study was concentrated on the rare earth–boric oxide system. Many amorphous boron samples have been examined to determine the influence of film properties on the conduction mechanism. Various dielectric films were investigated for use in field-effect devices. Life testing of thin-film triodes was continued. A free-running multivibrator accumulated more than 5,348 hours of operating time. Other devices and related developments are listed. D.E.W.

26 PROPELLANTS AND COMBUSTION

Includes fuels; igniters; and oxidizers. *For related information see*: 07 Chemistry; and 27 Propulsion.

N64-29431 Aerojet-General Corp., Azusa, Calif. Von Karman Center
INVESTIGATION OF THE MECHANISMS OF DECOMPOSITION, COMBUSTION, AND DETONATION OF SOLIDS
A. J. Secchi Jun. 1964 15 p refs
(Contract AF 49(638)-851; ARPA Order-24-60)
(Rept.-0372-01-17; AD-442487)

The volumetric reaction rate and heat release rate for this ammonia–chlorine flame reactions have been deduced from mass spectrographic analyses of the gaseous reaction products and from reaction parameters for the opposed-jet diffusion flame. The overall stoichiometry of the ammonia–oxygen flame reaction, in the pressure region of 200 to 760 torr, is best represented by the equation,

$$5\,NH_3 + 3\,O_2 \rightarrow 3/2\,H_2 + 5/2\,N_2 + 6\,H_2O.$$

The volumetric reaction rate and heat release rate for this reaction are 7.35 g/cm^3-sec and 2.52×10^4 cal/cm^3-sec, respectively. The overall stoichiometry of the ammonia-chlorine reaction at pressures ranging from 300 to 745 torr can be represented by,

$$7\,NH_2 + 3Cl_2 \rightarrow 5\,NH_4Cl + HCl + N_2.$$

The volumetric rate of reaction for this equation is 3.67 g/cm^3-sec, which corresponds to a volumetric heat release rate equal to 9.92×10^3 cal/cm^3-sec. Author

N64-29675 Malaker Labs., Inc., High Bridge, N.J.
KINETIC STUDY OF ROCKET EXHAUST GASES Progress Report No. 9, Period Ending Jul. 16, 1964
[1964] 23 p ref
(Contract DA-30-069-ORD-2918)
(Rept.-103-9; AD-602776) OTS: $2.00

Two experimental series have been conducted: (1) a study of spectrally resolved flame images; and (2) determination of flame temperatures, using the monochromatic photography technique. Both studies involved two propellant formulations designated by Picatinny Arsenal. Author

N64-29726 Humble Oil and Refining Co., Baytown, Tex.
ION-MOLECULE REACTIONS IN METHANE–OXYGEN AND ACETYLENE–OXYGEN SYSTEMS
J. L. Franklin and M. S. B. Munson Apr. 1964 25 p refs Presented at the 10th Intern. Symp. on Combust., Cambridge, U., Aug. 1964
(Contract Nonr-3623(00); Proj. Squid)
(HUM-6-P; AD-436604)

Studies of ion-molecule reactions in methane–oxygen and acetylene–oxygen mixtures show comparatively few and relatively slow reactions between the hydrocarbons and oxygen. In methane–oxygen mixtures, the principal cross-product ions are $CH_3O_2^+$, CH_2O^+, CHO^+, and CH_3O^+— the first two being formed from O_2^+, and the last two from CH_4^+. In addition, CH_4^+ reacts with O_2 to form CH_3^+. In acetylene–oxygen mixtures, $C_2H_2O^+$, CHO^+, and C_2HO^+ are the only cross-product ions formed in significant amounts. The first two are formed from O_2^+, and the latter probably comes principally from C_2H^+. The CH_2^+ and $C_3H_3^+$ are enhanced by oxygen, but the reactions are not well established. Author

N64-29799 Pennsylvania State U., University Park
DETERMINATION OF THE DECOMPOSITION KINETICS OF HYDRAZINE USING A SINGLE-PULSE SHOCK TUBE

E. T. Mc Hale, B. E. Knox, and H. B. Palmer Aug. 1964 30 p refs Presented at the 10th Intern. Symp. on Combust., Cambridge U., Aug. 1964
(Contract Nonr-3623(00); Proj. Squid)
(PSU-12-P; AD-605129)

The rate of decomposition of carefully purified hydrazine has been measured by a single-pulse shock tube method over the temperature range, 970° to 1,120° K and the pressure range, 2.3 to 8.6 atm, at a concentration of about 1 mole % in argon. The experimental data on reaction order, activation energy, and stoichiometry, together with kinetic and thermochemical considerations, lead to the conclusion that the decomposition kinetics obey a simple nonchain mechanism. Possible chain mechanisms are examined in detail and found to be at variance with the observations. A high-pressure limiting rate constant, $k_\infty = 10^{13.0} \exp(-54 \text{ kcal/RT}) \text{ sec}^{-1}$, is obtained for the reaction, $N_2H_4 \rightarrow 2\ NH_2$, over the temperature range from 970° to 1,550° K. Thus $D(H_2N\text{-}NH_2)$ is determined to be 54 kcal, with an uncertainty of about 2 kcal. Author

N64-29841 Purdue U., Lafayette, Ind. Jet Propulsion Center
ANALYSIS OF A SERVO SYSTEM FOR CONTINUOUS MEASUREMENT OF THE BURNING RATE OF A SOLID PROPELLANT Interim Report
J. R. Osborn and R. F. Panella May 1964 69 p refs
(Grant AF-AFOSR-207-63)
(JPC-374; I-64-4; AD-604556)

By controlling the position of the burning surface of the solid propellant within the rocket motor, the burning rate can be measured. The object of this project was to determine the servosystem dynamics. Stability, time response, and optimization of the servosystem were investigated. A theoretical analysis was made to determine component transfer functions. From the component transfer function the overall system transfer function was derived. The Bode diagram was then used to determine system stability. The system transfer function was programed on an analog computer, and the time response of the system was characterized. The servosystem was built, and experimental results were obtained to verify the theoretical system transfer function. The nonlinearity of the servosystem in the amplitude range considered was found to be 11%. The system transfer function was optimized using two different criteria—optimum phase margin and minimum ITAE. Author

N64-29855 Naval Air Development Center, Johnsville, Pa. Aviation Medical Acceleration Lab.
EFFECT OF OXYGEN ENRICHED ATMOSPHERES ON THE BURNING RATE OF FABRICS, PHASE II
Maria A. Chianta and Alice M. Stoll 26 Jun. 1964 17 p refs
(NADC-ML-6408; AD-603488)

This study, designed to ascertain the feasibility of oxygen enrichment of capsular environments without increasing clothing fire hazard, has revealed the following: (1) that under the conditions of these experiments, with the best fire-resistant clothing material available, only a 10% increase in oxygen concentration may be realized in an oxygen–nitrogen atmosphere irrespective of pressure; similarly, a 20% increase, if argon is used; (2) the existence and progression of the damping effect of inert gases; and (3) a means of extending observations made in one gaseous environment to any other of known physical properties. It is concluded that significant oxygen enrichment may be achieved safely only by introduction of a physiologically safe gas or gas mixture at least twice as dense as nitrogen. Author

N64-29955 Naval Research Lab., Washington, D.C. Fuels Branch
THE IGNITION AND COMBUSTION PROPERTIES OF ACTIVATED CARBON CONTAINING ADSORBED HYDROCARBONS
F. J. Woods and J. E. Johnson 28 Jul. 1964 32 p refs
(NRL-6090; AD-605193) OTS: $0.75

Activated carbon contained in large filter beds is used in nuclear submarines for removal of odors and trace contaminants. Because organic vapors are concentrated in this way in the carbon, a study was made to get information for assessing the fire hazards involved in maintaining the carbon filter in the ventilation system of the submarines. In this study, spontaneous ignition of submarine-exposed carbons occurred at temperatures as low as 490° F in air at one atmosphere. Exothermic oxidative reactions occurred in a flow system at temperatures as low as 390° F. Combustion of carbons containing hydrocarbon produced considerable quantities of carbon dioxide and carbon monoxide, and significant amounts of these gases were evolved even under precombustion conditions. Of a number of carbons that had been used in submarines, the lowest flash point found was 160° F. Author

N64-30009 Marquardt Corp., Van Nuys, Calif.
DESCRIPTION OF AN IBM-704 FORTRAN PROGRAM FOR THE ASSESSMENT OF COMBUSTION EFFICIENCY FOR A HYDROGEN AND AIR SYSTEM Technical Documentary Report, Oct. 1962–30 Nov. 1963
J. L. Shaw Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., 5 Sep. 1963 25 p refs
(Contract AF 33(657)-10796)
(APL-TDR-64-69; AD-601235)

An IBM-704 FORTRAN computer program is described that will determine the combustion efficiency of a given mixture of hydrogen and air, used as combustion reactants, within plus or minus 2 percent at combustion temperatures above 2,500° R. The combustion efficiency is defined as the ratio of the actual enthalpy release to the theoretical enthalpy release. This program is valid only for nonvitiated air and hydrogen fuel for any inlet enthalpy level of either air or hydrogen. Sample inputs and outputs and a program listing are presented. Author

N64-30086* Rocketdyne, Canoga Park, Calif.
INVESTIGATION OF CATALYTIC IGNITION OF OXYGEN/HYDROGEN SYSTEMS Final Report, 19 Jun. 1963–19 Apr. 1964
R. W. Roberts Aug. 1964 156 p refs
(Contract NAS3-2565)
(NASA-CR-54086; R-5709) OTS: $11.50 ph

The results of an investigation of catalytic ignition of the oxygen–hydrogen system are presented. Included in this report are the results of preliminary laboratory screening for catalyst surface characterization and relative activity measurements at various temperatures for several commercially available catalysts. Also included are ignition evaluations of selected catalysts at environmental temperatures of −250° F for both catalyst and propellants, and of evaluations with liquid propellants and catalyst environmental temperatures equivalent to those of liquid hydrogen. Ignition lag measurements are presented for reaction systems with both liquid and gaseous propellants. Author

N64-30144 Bureau of Mines, Pittsburgh, Pa. Explosives Research Lab.
INITIATION OF DETONATION BY LOW AMPLITUDE SHOCKS Quarterly Report, Feb. 1–Apr. 30, 1963

F. C. Gibson, R. W. Watson, C. R. Summers, F. H. Scott, and E. J. Hay 28 May 1963 22 p
(ARPA Order-44-63)
(AD-406438)

The initiation and growth of detonation in explosives and propellants were investigated, and particular emphasis was placed on reactions resulting from initiation by low-amplitude shocks. An expendable pressure transducer was used to study the behavior of nitroglycerin ethylene glycol dinitrate (NG-EGDN) during the period between the application of the initial shock and subsequent reactions. The transducer consisted of a resistive element imbedded in a polyethylene rod that was immersed in the liquid to a predetermined level. Framing-camera studies were also performed simultaneously to aid in interpreting the pressure–time traces. D.E.W.

N64-30145 Phillips Petroleum Co., Bartlesville, Okla. Research Div.
MICROBURNER STUDIES OF FLAME RADIATION AS RELATED TO HYDROCARBON STRUCTURE Progress Report No. 4
R. M. Schirmer and E. W. Aldrich May 1964 71 p refs
(Contract NOw-63-0406-d)
(RR-3752-64R; AD-602153)

Measurements have been made of total radiant energy from flames for a series of pure hydrocarbons, varying widely in molecular structure and boiling point. This study was conducted using the Phillips microburner, which simulates conditions for combustion existing in an aircraft gas turbine engine. The microburner tests did not differentiate among hydrocarbons (including all of the normal- and iso-paraffins, the mono- and bi-cycloparaffins, and the straight and branch chain olefins) having hydrogen contents above about 13 wt.%, heats of combustion above about 18,200, luminometer numbers above about 40, and ASTM smoke points above about 20 mm. At lower values, the total radiant energy increased rapidly with decrease in these properties. The hydrocarbons, other than those listed above, were rated in the following order of increasing flame radiation: the cycloolefins, tetracyclododecane, tetralin and the alkylbenzenes, benzene and styrene, and methylnaphthalene. The results also show that fuel volatility was not a significant factor under the test conditions. Author

27 PROPULSION

Includes airbreathing, electric, liquid, nuclear, and solid propulsion. *For related information see*: 04 Aircraft; 06 Auxiliary Systems; 26 Propellants and Combustion; and 30 Space Vehicles.

N64-29026 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THIS IS HOW IT ALL BEGAN
I. Merkulov 17 Jul. 1963 10 p Transl. into ENGLISH from Znaniye-Sila (USSR), no. 9, 1962 p 4–6
(FTD-TT-63-612/1+2; AD-414132)

Rocket-engine development in the U.S.S.R. from 1932 through 1942 is reviewed. Various types of engines are described, beginning with the OR-2, which was operated on gasoline and liquid oxygen and generated a thrust of 50 kilograms during its firing in 1933. The first Soviet rocket flew into the sky on August 17, 1933. It was 2.4 meters in length, with a diameter of 180 mm. The launching weight consisted of 19 kg, of which 6.2 kg was payload (apparatus and parachute). In 1940, the pilot V. K. Fedorov accomplished the first flight in the rocket aircraft "SK-9," which had a liquid reaction engine. In 1939 to 1940, the pilot P. Ye. Loginov successfully conducted flight tests of ramjet engines that were installed as booster engines on an aircraft. In 1942, the pilot G. Ya. Bakhchivandzhi completed the first flight in a rocket fighter aircraft. I.v.L

N64-29178* National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
BOOSTER PARAMETRIC DESIGN METHOD FOR PERFORMANCE AND TRAJECTORY ANALYSIS. PART II: PROPULSION
V. Verderaime 2 Jun. 1964 29 p refs
(NASA-TM-X-53053) OTS: $2.60 ph

Approximate equations for large, liquid chemical, rocket engine mass and space envelope are presented in parametric form. Well-known propulsion performance equations are given with modifications to admit programing of mixture ratio shifts and throttling of propellant mass flow rate. Parameters used in mass and space envelope equations were nominal input design parameters in common with the propulsion performance equations, such that their interdependence could be manifested in a vehicle trajectory and performance optimization study. Author

N64-29196* Marquardt Corp., Van Nuys, Calif.
SPACECRAFT ENGINE THRUST CHAMBER COOLING Final Report, 13 May 1963–12 Apr. 1964
J. G. Campbell, M. D. Carey, C. F. Sanders, Jr., and C. D. Coulbert 22 Jul. 1964 205 p refs
(Contract NAS7-103)
(NASA-CR-58249; Rept.-6069) OTS: $14.00 ph

Thrust chamber cooling techniques, applicable to liquid rocket engines using propellant combinations having combustion temperatures up to 8,500° F, have been investigated analytically and experimentally. Two of the most promising thermal protection concepts developed during this program and demonstrated experimentally were the concept of a multislot film-cooled pyrolytic graphite and the concept of reducing graphite chemical erosion by the injection of a gaseous hydrocarbon film to provide a favorable chemical environment in the nozzle boundary layer. These investigations have also provided additional design data and criteria for the selection and application of various cooling concepts. A heat-sink design optimization study has resulted in a technique for establishing optimum nozzle wall thicknesses, based on combustion conditions, material properties, and engine size. I.v.L

N64-29222* General Dynamics/Astronautics, San Diego, Calif.
DEVELOPMENT OF A COAXIAL PLASMA GUN FOR SPACE PROPULSION
Terence J. Gooding, Bruce R. Hayworth, Alan V. Larson, and David E. T. F. Ashby Jun. 1964 67 p refs
(Contract NAS3-2594)
(NASA-CR-54149; GD/A-DBE-64-051) OTS: $6.60 ph

A description is given of the work done in an experimental program to evaluate the pulsed coaxial plasma gun as a thrustor for space propulsion applications. The pursuit of efficiency has led to the development of a low-loss, lightweight energy storage capacitor, which exhibits pulse line behavior. An energy inventory shows that the plasma resistive losses are small and that the accelerator efficiency is not limited by poor

energy transfer from the energy source to the plasma. The thermal efficiency (exhaust energy–stored energy) has been increased to 45% at an average exhaust velocity of about 7 cm/μsec. A theoretical discussion shows that a significantly higher efficiency cannot be expected with the present mode of operation, but that two other modes are available that in principle have no such limitation. Author

N64-29227* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ENGINE-INTEGRATED SECONDARY INJECTION SIDE-FORCE GENERATION FOR THE HYDROGEN-FUELED ROCKET ENGINE
William J. D. Escher and Donald D. Thompson 8 Nov. 1962 84 p refs
(NASA-TM-X-51919; MTP-P&VE-P-62-10) OTS: $8.10 ph

The concept of engine side-force generation (gaseous secondary injection in hydrogen-fueled engines) is reviewed briefly. Much analytical and experimental research has been conducted in secondary injection; however, coherent supporting work applicable to the use of hydrogen as an injectant, either alone or in conjunction with combustion products, is insubstantial. To provide the needed analytical results and a substantiating experimental program, study was focused on hydrogen secondary injection. Author

N64-29238 Marine Engineering Lab., Annapolis, Md.
A METHOD FOR SYNTHESIS AND SELECTION OF PROPULSION PLANTS FOR SUBMARINES
James F. Blose and Joseph F. Mc Cartney 19 Jun. 1964 38 p refs
(MEL-67-64; AD-602102) OTS: $1.25

New concepts for submarine propulsion plants are continuously being presented to the Navy for review and possible application. An analytical method is now being used to determine the effect of powerplant weight and thermal efficiency on the cruising radius, speed, and vessel displacement. A mathematical model representing the propulsion plant and vessel hull was prepared and, by means of a digital computer, the effects of varying several design parameters were studied. By comparing the predicted performance of several types of powerplants with the results of the computer study it is possible to select those that justify further development for Navy use. Author

N64-29275 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
PHYSICAL PROPERTIES OF ROCKET FLIGHT
A. A. Dmitriyevskiy and V. N. Koshevoy 21 Jun. 1963 94 p refs Transl. into ENGLISH of the book Fizicheskiye Osnovy Poleta Raket Moscow, Izd. Min. Oborony SSSR, 1962 p 1–80
(FTD-TT-63-345/1+2; AD-412958)

The brochure describes the operating principles of jet-propelled motion, as applied to the flight of rockets for different purposes; gives information on mechanics and on gases, necessary for the understanding of the physical principles of thrust production; and considers the forces acting on controlled and uncontrolled rockets as they move. It describes various methods of stabilizing the rocket during its motion, and considers the features of flight and the trajectories of motion of various types of rockets. Author

N64-29411 Hiller Aircraft Corp., Palo Alto, Calif. Advanced Planning and Research Div.
PULSE REACTOR LIFT-PROPULSION SYSTEM DEVELOPMENT PROGRAM Final Report
R. M. Lockwood, J. B. Nichols et al Mar. 1963 230 p refs
(Contract NOw-61-0226-c)
(ARD-308; AD-601715)

The pulse-reactor-engine program is aimed at developing efficient high-performance lift-propulsion systems that have no moving parts. The pulse reactor engine is unique in that it rejects foreign particles that are denser than air; therefore it can operate in the interface between ground and air, which is denied to other aircraft lift-propulsion systems. This report summarizes development concerned with the performance effects of engine size, new reactor shapes, forward flight and vertical flight, engine controls and accessories, and pulse-reactor materials, construction techniques, and engine durability. I.v.L.

N64-29495* Electro-Optical Systems, Inc., Pasadena, Calif.
ION ROCKET SYSTEM RESEARCH AND DEVELOPMENT Quarterly Report, 1 Jun.–31 Aug. 1964
G. C. Reid, F. A. Barcatta, G. Sohl, and R. C. Speiser 20 Sep. 1964 63 p
(Contract NAS3-5250)
(NASA-CR-54026; EOS-4920-Q-2) OTS: $6.60 ph

Work performed on an electron bombardment cesium ion rocket system is reported. A long duration engine system test is described including operating parameters during the run and analyses of components upon termination of the test. A new permanent magnet engine is reported, and the results of plasma distribution studies and autocathode tests are discussed. Author

N64-29522* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
ASTRONAUTICS INFORMATION. ELECTRIC PROPULSION Literature Search No. 587
Judith Hayes, comp. Jun. 1964 120 p refs
(Contract NAS7-100)
(NASA-CR-58361; JPL-AI/LS-587) OTS: $9.60 ph

This literature search has been compiled to update and supplement a search entitled "Electrically Propelled Spacecraft and Associated Subjects" issued in May 1962. The annotated references are classified into five general categories: General, Electromagnetic, Electrostatic, Electrothermal, and Nuclear-Electric. Within each section, references are arranged in chronological order. An author index and corporate-source index are included. D.S.G.

N64-29558* Lockheed Missiles and Space Co., Sunnyvale, Calif.
RIFT RADIATION EFFECTS PROGRAM: IRRADIATIONS NO. 5 AND 8 ELECTRICAL CABLES
A. J. Steele and H. F. Plank 15 Apr. 1964 70 p refs
(Contracts NAS8-5600; NAS8-9500)
(NASA-CR-56779; NSP-64-25) OTS: $6.60 ph

Presented are the results of measurements made during irradiation of coaxial cables RG 58C/U and RG 141/U; multiconductor cables MD-324, CDS-47831, PSC-C-39001, and RT 24(19)ST; and connector PT00P-14-5 S/PT06P-14-5 P. These cables were tested at 70° C under radiation dose rates of 10^4 to 2×10^6 r/hr and at total doses to 3×10^7 r. The conductance and currents found for the minimum and maximum dose rates are shown in a table. The empirical equations derived for slab geometry of dielectrics were not applicable to the majority of the data. Author

N64-29599* Electro-Optical Systems, Inc., Pasadena, Calif.
ANNULAR MAGNETIC HALL CURRENT ACCELERATOR
Gordon L. Cann [1964] 65 p refs Presented at the AIAA 4th Elec. Propulsion Conf., Philadelphia, 31 Aug.–2 Sep. 1964
(Contract NAS3-3568)
(AIAA Paper-64-670) AIAA: $0.50 members, $1.00 nonmembers

Recent experiments indicate that a combined electric arc and Hall current accelerator can provide a very flexible, yet high performance, type of electric propulsion engine. The same engine has been run over a range of specific impulse of from 1,000 to 12,000 sec with H_2 propellant at efficiencies from 20% to 70%. Comparable performance has been obtained with other propellants. An engine in which the electrodes were cooled by radiation and specific impulse using hydrogen as the propellant is described. This device was run for over 40 hours at an I_{sp} of 4,000 sec, and no electrode material could be found in the jet by spectroscopic examination. Engines have been run over a power range of 2 to 300 kw. The thrust from the engine is due primarily to Hall current acceleration of the propellant gas, though other mechanisms also contribute. Author

N64-29706* Aerojet-General Corp., Sacramento, Calif. Advanced Technology Div.
HIGH CHAMBER PRESSURE OPERATION FOR LAUNCH VEHICLE ENGINES PROGRAM Final Report, 1 Apr. 1963–31 Mar. 1964
R. Beichel 1 Jun. 1964 97 p refs
(Contract NAS8-4008)
(NASA-CR-56672; Rept.-4008-SA4-F) OTS: $8.60 ph

The effects of chamber pressure, injector type and size, and thrust chamber length on combustion stability were experimentally and theoretically studied. A series of 21 valid tests was conducted using LO_2/LH_2 as propellants. The sensitive time lag theory was used for evaluation and correlation of experimental test results. The test program included tests with 6-, 12.5-, and 26-in.-length chambers using pentad (5,000-lb thrust per element), coaxial (1,100-lb thrust per element), and conventional (220-lb thrust per element) types of injectors, in an 8-in.-diam chamber. The conventional injector was observed to be marginally unstable in the first tangential mode over the range of pressures (1,000 to 2,500 psia) and chamber lengths employed. The coaxial injector also showed instability; but it was found to be in the first longitudinal mode, and only with the 26-in.-length chamber at 2,500 psia. The pentad injector was stable over the entire ranges of pressure and length. Author

N64-29780 France. Office National d'Etudes et de Recherches Aeronautiques, Chatillon-sous-Bagneux
APPLICATION OF ATMOSPHERIC PROPULSION TO THE ATTAINMENT OF GREAT VELOCITIES [L'APPLICATION DE LA PROPULSION ATMOSPHERIQUE A L'ACQUISITION DES GRANDES VITESSES]
Pierre Contensou [1964] 23 p In FRENCH Presented at the 4th European Space Symp., Rome, 20–21 Jun. 1964 *Its* T.P. No. 139(1964)

The principal advantage of using atmospheric engines to orbit space vehicles is the extremely high specific impulse that can be obtained with these engines. In order to establish the relative merits of statoreactors vs rockets as well as the modalities and further advantages of using them in combination, a general theory of the optimization of the trajectory of a launch vehicle leaving the earth is developed. The results of the theory are applied to both rockets and statoreactors. Finally, a second approximation of the induced drag is given for the limited case of quasi-horizontal trajectories. M.P.G.

N64-29782* General Electric Co., Cincinnati, Ohio Flight Propulsion Lab. Dept.
INTRODUCTION TO NUCLEAR PROPULSION: INTRODUCTION AND BACKGROUND Lecture 1, Feb. 26–28, 1963
Gunnar Thornton [1963] 82 p refs
(Contract NAS8-5215)
(NASA-CR-52961; GEMP-190A) OTS: $8.10 ph

This introductory lecture gives a historical survey of gas-cooled reactor development—nuclear turbojet reactor development, nuclear ramjet reactors (Tory II-A and Tory II-C), nuclear rocket reactors, and the technical differences between chemical and nuclear systems. I.v.L.

N64-29783* General Electric Co., Cincinnati, Ohio Flight Propulsion Lab. Dept.
INTRODUCTION TO NUCLEAR PROPULSION: NUCLEAR SAFETY Lecture 16, Apr. 23–25, 1963
R. B. O'Brien, G. Briscoe, G. E. Denning, J. H. Lofthouse [1963] 41 p refs
(Contract NAS8-5215)
(NASA-CR-52946; GEMP-190K) OTS: $4.60 ph

The general requirements of a nuclear safety control program are considered. Safety and hazards analysis takes into account accidents, normal operating hazards, and maintenance and servicing hazards. Probable effects, the provision of safeguards, and the limiting of operations under unfavorable atmospheric diffusion conditions are discussed. Other topics include the biological considerations of radiological hazards, the calculation of effluent hazards, and the regulatory requirements in the way of documentation, preanalysis, and proposed controlling procedures. R.L.K.

N64-29784* General Electric Co., Cincinnati, Ohio Flight Propulsion Lab. Dept.
INTRODUCTION TO NUCLEAR PROPULSION: NUCLEAR TEST OPERATIONS Lecture 15, Apr. 23–25, 1963
C. L. Storrs and R. L. Drexler [1963] 43 p refs
(Contract NAS8-5215)
(NASA-CR-52945; GEMP-190J) OTS: $4.60 ph

Described are the following: (1) radiation protection, viewing, handling and maintenance, and control and data systems at test facilities; (2) the general procedure followed in performing a nuclear rocket test; (3) remote handling philosophy and equipment; and (4) postoperational laboratory examination. R.L.K.

N64-29789* General Electric Co., Cincinnati, Ohio Flight Propulsion Lab. Dept.
INTRODUCTION TO NUCLEAR PROPULSION: REACTOR THERMAL DESIGN Lecture 9 and 10, Mar. 26–28, 1963
C. W. Moon [1963] 126 p refs
(Contract NAS8-5215)
(NASA-CR-52956; GEMP-190F) OTS: $10.10 ph

Reactor thermal design involves the transition of system imposed flow, pressure and temperature constants, together with predicted power-distribution characteristics, into requirements for the mechanical configuration of the reactor, and involves corresponding predictions of temperatures within the reactor. Included in this report are the tabulation of temperature ratios for typical ANP reactors and the postulated temperatures for a nuclear reactor for use in a rocket engine, i.e., inlet-gas temperature 0° F, exit-gas temperature 4,000° F, and fuel element hot-spot temperature 5,000° F. It can be tentatively concluded that the achieved distribution of the difference between hot-spot temperature and the exit-gas temperature, among the several temperature-difference ratios, is reasonable. I.v.L.

N64-30033* Thompson Ramo Wooldridge, Inc., Cleveland, Ohio Electromechanical Div.
POROUS MATRIX PHASE SEPARATOR EVALUATION Final Report, Mar. 1963–Jul. 1964
Keith M. Montgomery 18 Sep. 1964 37 p ref
(Contract NAS3-2518)
(NASA-CR-54152; TRW-ER-6116) OTS: $3.60 ph

A porous matrix phase separator, of the type proposed for use in a cesium feed system of an ion propulsion rocket, was evaluated for plugging and deterioration in a vaporization experiment. The experiment was concluded after 2,100 hours of continuous cesium boiling at 800° F. Radiographs taken periodically during the course of the experiment, and post-experiment metallographic and spectrographic examination of the three matrices tested revealed no deterioration of the matrices and only insignificant plugging. Author

N64-30093* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
SOME REQUIREMENTS OF ELECTRIC AND CHEMICAL THRUST SYSTEMS FOR SPACE STATION DRAG CANCELLATION
Dennis W. Brown Washington, NASA, Sep. 1964 9 p refs
(NASA-TN-D-1835) OTS: $0.50

Four electric thrust devices and three chemical thrust devices are compared for the application of atmospheric drag cancellation on four assumed space-station configurations. The chemical propulsion systems require as much as five times the total system weight of the ion rocket systems for a 5-year mission even when solar cells are the source of electrical power. Electric power requirements for the electric rocket systems are on the order of a few hundred watts for the resisto-jet and range from 3 to 15 kw for the ion rocket. Resisto-jets appear to be a satisfactory compromise between total system weight and power. Author

N64-30109 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
OPTIMUM THRUST-CONTROL REGIMES FOR CERTAIN ROCKETS
P. Brandeanu and I. Pavaloiu 14 Jul. 1964 17 p refs Transl. into ENGLISH from Studii Cercetari de Mecanica Aplicata (Bucharest), v. 14, no. 4, 1963 p 805–816
(FTD-TT-64-615/1+3+4; AD-603332)

The paper determines the optimum thrust direction program for certain types of rockets in consideration of the earth's revolution on its axis. The solution is reached through quadratic equations and evaluated by numerical methods. It is assumed that air resistance is negligible and that the gravitational field is plane-parallel and constant. A.W.

N64-30121 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE PROBLEM OF DETERMINING THE OPTIMUM CRITICAL OPERATING PARAMETERS FOR A NONISOBARIC MOTOR WITH DIVERGENT NOZZLE
R. Staniszewski 4 Aug. 1964 54 p refs Transl. into ENGLISH from Arch. Budowy Maszyn (Warsaw), v. 10, no. 2, 1963 p 103–140
(FTD-TT-64-497/1+2+3+4; AD-603947)

The problem of nonsteady-state operation of a liquid rocket motor is solved, using the dynamical differential equations of turbulent flow. The solutions are used to determine the optimum and critical parameters, together with the stability limits, on the basis of a nonisobaric motor model. The determination of these parameters makes it possible to correct the design method used for rocket motors. Author

N64-30124 Air Force Systems Command, Wright-Patterson AFB, Ohio AF Aero-Propulsion Lab.
ARC-OVER AND RAPID PUMPDOWN TESTS ON THE CESIUM CONTACT IONIZATION ENGINE FLIGHT TEST PAYLOAD
Edward T. Mahefkey and Robert H. Johnson May 1964 30p
(Contract AF 33(657)-7285)
(ASD-TDR-63-867; AD-601837)

Flight profile simulation tests of a cesium ion engine flight test payload were conducted to investigate possible causes of the failure incurred in the first in-space flight test of the cesium ion engine. The engine package, composed of the engine and power conditioning equipment, was subjected to a series of flight pressure profile tests to determine the behavior of the package during launch. Steady state arc-over pressure tests were also made to ascertain the pressure at which high-voltage gaseous breakdown would occur. The results of these tests proved that the engine package is a negligible outgassing source. The pressure at which steady-state arc-over was experienced was shown to be relatively high, proving that any arc-over experienced in the flight test was not initiated by outgassing in the engine package. Author

28 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. *For related information see*: 05 Astronomy and Astrophysics; 16 Life Sciences; and 29 Space Sciences.

N64-29084 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
CALCULATION OF OUTGOING LONG-WAVE RADIATION USING ARTIFICIAL EARTH SATELLITE DATA
M. Ye. Shvets *In its* Cosmic Res., v. 2, no. 2 8 Jun. 1964 p 157–162 (See N64-29076 21-01)

A method is presented for calculation of outgoing long-wave radiation flux that is averaged for a small area. This method uses radiation-measurement data from an artificial earth satellite that is equipped with a wide-angle device. Author

N64-29086 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
COSMIC RADIATION ANALYSIS AT HEIGHTS OF 200–350km ON COSMOS 4 AND 7
R. N. Basilova, S. N. Vernov, V. E. Nesterov, N. E. Pisarenko, I. A. Savenko et al *In its* Cosmic Res., v. 2, no. 2 8 Jun. 1964 p 170–182 refs (See N64-29076 21-01)

Thirteen points of the cosmic ray equator were found as a result of analyzing the counting rate of the STS-5 gas-discharge counter placed aboard Cosmos 4 and 7. The longitudinal variation of the STS-5 minimal counting rate was discovered. A relation was found between the STS-5 counting rate and the threshold magnetic rigidity by Quenby and Wenk. Author

N64-29087 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
GEOGRAPHIC LOCATION OF PARTICLE INTENSITY MAXIMA IN THE OUTER RADIATION BELT AT LOW ALTITUDES

S. N. Vernov, V. N. Erofeeva, V. E. Nesterov, I. A. Savenko, and P. I. Shavrin *In its* Cosmic Res., v. 2, no. 2 8 Jun. 1964 p 183–193 refs (See N64-29076 21-01)

The location of intensity maxima was determined in the outer radiation belt at the flight altitudes of the second and third spaceships and Cosmos-4. The location of experimentally determined maxima was compared with the drift trajectories of mirror points and with aurora polaris isochasms. The relation between the location of intensity maxima and the degree of disturbance of the earth's magnetic field was examined. Author

N64-29089 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

COSMIC RADIATION TISSUE DOSE RECEIVED BY V. F. BYKOVSKIY AND V. V. NIKOLAEVA-TERESHKOVA DURING THEIR JOINT FLIGHT

I. A. Bochvar, A. A. Vasilyeva, I. B. Keirim-Markus, T. P. Prosina, N. A. Sergeeva et al *In its* Cosmic Res., v. 2, no. 2 8 Jun. 1964 p 208–211 refs (See N64-29076 21-01)

This article cites the results of dosimetric measurements on board Vostok 5 and 6, which agree with previous measurements. The upper value of the neutron flux in the spaceship cabins is derived. It was observed that near the cabin walls the dose was 2 to 3 times higher than in the center. Author

N64-29098 Utah Research and Development Co., Inc., Salt Lake City

STUDY OF PHENOMENA RESULTING FROM HYPERVELOCITY IMPACT

Thomas W. Lee Eglin AFB, Fla., Res. and Technol. Div., Mar. 1964 73 p refs

(Contract AF 08(635)-3154)

(ATL-TDR-64-24; AD-445704)

Some of the problems pertaining to the feasibility of detecting an impact flash in space are discussed. Criteria are derived for detection of radiation when it is assumed that a detector of several square cm at 1-km distance or several square meters at 100-km distance is used. The impact flash radiation is investigated experimentally for different regions of the electromagnetic spectrum. It is found that radiation in the radiofrequency range from 3- to 5-cm wavelength is not sufficiently intense to be used as a signature mechanism. Radiation in the 0.4, 0.8, and 1 to 7 micron region contains enough energy to be detected and used as a signature mechanism. It is found that radiation is relatively independent of ambient pressure at pressures less than 10^{-2} mm of mercury. It is also found that the power per steradian increases as energy to the 2.5 power, or velocity to the fifth power, for the impact of aluminum projectiles against steel targets. Author

N64-29290 Oslo U., Blindern (Norway) Inst. of Theoretical Astrophysics

SECULAR VARIATIONS OF INTERMITTENT AND REVIVAL SUNSPOT GROUPS Scientific Report No. 21(43)

Truls S. Ringnes 1964 35 p refs *Its* Astrophys. Norvegica, v. VIII, no. 6

(Contract AF 61(052)-186)

(AFCRL-64-618; AD-444697)

This report discusses investigations of secular variations, distinct from the 11-year period, in number, composition, and in other properties of the two types of sunspot groups called intermittent and revival groups. I.v.L.

N64-29291 Oslo U., Blindern (Norway) Inst. of Theoretical Astrophysics

SECULAR VARIATIONS OF SUNSPOTS WITH LIFETIMES FROM TWO TO EIGHT DAYS Scientific Report No. 23(45)

Truls S. Ringnes 1964 45 p refs *Its* Astrophys. Norvegica, v. VIII, no. 7

(Contract AF 61(052)-186)

(AFCRL-64-620; AD-444696)

Sunspot groups with lifetimes from 2 to 8 days, which were born and decayed within 60° from the central meridian, have been studied in terms of features, such as number, the increase in mean and maximum area with lifetime, and the dependence of area on age for groups of a given lifetime. The period under study, 1884 to 1958, has been considered as a whole, but individual cycles have also been studied. Several secular variations have been found. Author

N64-29340* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ELECTRON LOSS RATE FROM THE OUTER RADIATION BELT

W. N. Hess, S. D. Bloom, L. G. Mann, F. D. Seward, and H. I. West, Jr. (Calif. U., Livermore Lawrence Radiation Lab.) [1962] 17 p refs

(NASA-RP-307)

The rate of loss of electrons from the outer radiation belt is obtained by using recent electron flux measurements on Discoverer satellites and by assuming that the coulomb scattering dominates as the loss process. This results in an average lifetime of the order of 100 years for outer belt electrons. Author

N64-29416* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE SOLAR EXTREME ULTRAVIOLET RADIATION (1-400 A)

John C. Lindsay Repr. from Planet. Space Sci, v. 12, 1964 p 379–391 refs

(NASA-RP-288)

The principal observations discussed may be summarized as follows: (1) A slowly varying component has been observed in the solar X-ray flux that correlates with the slowly varying component of the 2,800 mc solar radiation and with the plage activity. (2) The lowest X-ray flux that has been measured from satellites was for $\lambda < 8A$, 3.6×10^{-5} ergs cm^{-2}/sec; for $\lambda < 11$ A, 1.8×10^{-4} ergs cm^{-2}/sec. This may be considered as an upper bound from a "quiet" sun. (3) When the sun emits an X-ray flux of $\lambda < 8$ A in excess of 0.6×10^{-3} ergs cm^{-3}/sec some optical indication of activity is usually observed. If the flux is in excess of 2×10^{-3} erg cm^{-2}/sec radio fadeout and other SID phenomena occur. (4) Out of several hundred hours of observation only 6 hrs were found in which the X-ray flux did not vary by more than 5%. (5) The flare associated X-ray spectrum was observed to harden as compared with preflare spectrum. (6) The He II (304 A) emission is enhanced by a factor of about 33% during a period when the Zurich Provisional Relative Sunspot Number increased from zero to a maximum of 94 and the 2,800 mc flux varied from approximately 76 to 125×10^{-22} wm^{-2}/Hz. (7) The enhancements of He II (304 A), and Fe XV (284 A), and Fe XVI (335 A) due to plage activity were much larger than enhancements due to flares that occurred during the 3-month) interval of the observations. Author

N64-29908 Air Force Cambridge Research Labs., Bedford, Mass. Office of Aerospace Research
IONOSPHERIC PERTURBATIONS, SOLAR FLARES, AND GEOMAGNETIC STORMS-CORRELATIONS OBSERVED BY OBLIQUE LONG-RANGE HIGH-FREQUENCY PROBING
Helen R. Baker and Alfred E. Reilly Jun. 1964 81 p refs *Its* Environmental Res. Papers No. 22
(AFCRL-64-455; AD-605269)

Highly stable experimental HF radio links were established over long paths by means of ionospheric propagation. The received signal was analyzed and its variability characterized as to type. It has been possible to correlate the occurrence of certain types of characteristic variations with the occurrence of certain natural events, such as solar flares and geomagnetic storms. These phenomena are associated with variations in the electromagnetic properties of the ionosphere that perturb the signal propagating through it. Author

29 SPACE SCIENCES

Includes space chemistry; cosmology; lunar and planetary exploration; and theoretical analysis of orbits and trajectories. *For space biology see*: 16 Life Sciences. *For related information see*: 05 Astronomy and Astrophysics; 12 Geophysics; and 22 Navigation and Guidance.

N64-29077 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
EVOLUTION OF THE ORBIT OF A CIRCULAR SATELLITE MOVING IN THE GRAVITATIONAL FIELD OF THE TERRESTRIAL SPHEROID
G. V. Samoylovich *In its* Cosmic Res., V. 2, No. 2 8 Jun. 1964 p 1–30 refs (See N64-29076 21-01)

Using the small-parameter method, analytic dependencies are sought that describe the perturbed motion of an artificial satellite under the action of the second zonal spherical harmonic of the gravitational potential of the earth. The equations obtained are used for a qualitative study of the form and position of the osculatory orbit of circular and near-circular satellites. Author

N64-29078 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
APPROXIMATION FORMULAS FOR DETERMINING THE LIFETIME OF ARTIFICIAL EARTH SATELLITES
P. Ye. El'Yasberg *In its* Cosmic Res., V. 2, No. 2 8 Jun. 1964 p 31–60 refs (See N64-29076 21-01)

The article is devoted to the derivation of approximation formulas for determining the lifetime of artificial satellites traveling at relatively low heights, for which the perturbing influence of the sun and moon may be neglected. A system of approximation formulas is obtained that encompasses the entire possible range of eccentricity variation $0 \leq e < 1$. An evaluation of the systematic errors of the approximation formulas obtained is given. Author

N64-29081 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
SOME QUESTIONS ABOUT THE INTERPRETATION OF RADIATION MEASUREMENTS FROM SATELLITES
M. S. Malkevich *In its* Cosmic Res., V. 2, No. 2 8 Jun. 1964 p 109–130 refs (See N64-29076 21-01)

Methods are examined for determining some physical parameters of the atmosphere and of the underlying surface with respect to the measurements of radiation in different regions of the spectrum which were obtained by satellites. The proposed methods of solving the corresponding inverse problems (determination of the temperature of the underlying surface and the atmosphere, mass of the substance absorbing radiation, and height of the upper bound of clouds) are illustrated by examples. The calculation of the atmospheric "noise" when determining the space structure of the underlying surface is discussed. Author

N64-29187* Rocketdyne, Canoga Park, Calif.
PROPULSION REQUIREMENTS FOR SOFT LANDING IN EXTRATERRESTRIAL ENVIRONMENTS VOLUME III. APPENDICES Final Report
Martin S. Bensky Feb. 1963 117 p refs
(Contract NAS7-124)
(NASA-CR-58035; R-5061) OTS: $9.60 ph

This volume contains a survey of extraterrestrial environments, a description of vehicle systems for several interplanetary missions, an investigation of start systems for extraterrestrial landing propulsion systems, a design study of lunar landing impact devices, and an analytical study of propellant storage on the lunar surface. Author

N64-29215* Massachusetts Inst. of Tech., Cambridge Experimental Astronomy Lab.
SINGULARITIES IN THE ANALYTIC SOLUTION OF THE LINEARIZED VARIATIONAL EQUATIONS OF ELLIPTICAL MOTION
Robert G. Stern May 1964 17 p refs Presented at the Astrodyn. Session of the 1st Ann. Meeting and Tech. Display of the Am. Inst. of Aeron. and Astron., Wash., D.C., 1 Jul. 1964
(Contract NAS9-153; Grant NsG-254-62)
(NASA-CR-58703; RE-8) OTS: $1.60 ph

An analytic solution is presented for the linearized three-dimensional variational equations of elliptical motion. For guidance purposes, a useful choice of the six required integration constants consists of the three components of position variation at each of two specified times. There are certain combinations of the two times for which no solution exists because the six-by-six matrix that must be inverted becomes singular. This paper explains the significance of the singularities. The singularities fall into three categories. The first two types occur when the difference in true anomaly between the two specified times is an integer multiple of 180°. The third singularity type occurs when the two specified times are related in such a way that the time of flight is a minimum for the given difference in true anomaly; it is explained mathematically as a consequence of the initial assumption of a linearized model. Author

N64-29312 Aerospace Corp., El Segundo, Calif. Systems Research and Planning Div.
LANDING SITE COVERAGE FOR ORBITAL LIFTING RE-ENTRY VEHICLES
R. G. Stern and S. T. Chu 1 Apr. 1963 89 p ref
(Contract AF 04(695)-169)
(SSD-TDR-63-97; TDR-169(3530-10)TN-1; AD-405109)

The problem of landing-site coverage of orbiting vehicles with maneuvering capability is analyzed. Discussed is the determination of the latitude coverage of a landing site per orbital period for the reentry vehicle with a given maneuver

capability defined by a rectangularly shaped "landing footprint." Related is the required latitude coverage to guarantee that, within a specific waiting time in orbit, the vehicle would attain a position from which it could be deboosted from orbit and would subsequently land at a preselected location. Extensive numerical results are obtained and presented in convenient graphical form. Author

N64-29337* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A SERIES SOLUTION FOR SOME PERIODIC ORBITS IN THE RESTRICTED THREE-BODY PROBLEM ACCORDING TO THE PERTURBATION METHOD
Su-Shu Huang Washington, NASA, Sep. 1964 17 p refs
(NASA-TN-D-2488) OTS: $0.50

A series is obtained for those periodic orbits surrounding the more massive of the two finite bodies in the restricted three-body problem. The expansion is in terms of the mass of the less massive finite body. The initial conditions predicted by the series for several periodic orbits are compared with those obtained by purely numerical processes. They are in good agreement for the case corresponding to the earth–moon system. Also, a simple theory of nearly periodic orbits in the neighborhood of a periodic orbit is developed and numerically verified by examples. Author

N64-29408* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
EARTH-MARS TRAJECTORIES, 1964, VOLUME 1, PART C
V. C. Clarke, Jr., R. Y. Roth, W. E. Bollman, T. W. Hamilton, and C. G. Pfeiffer 1 Apr. 1964 858 p refs
(Contract NAS7-100)
(NASA-CR-58244; JPL-TM-33-100, Vol. 1, Pt. C) OTS: $33.50 ph

This volume is one of a set of seven giving the key characteristics of Earth-to-Mars ballistic trajectories during the period 1964–1977; the period is divided into seven launch intervals (one interval per volume) spaced about 25 months apart. Within each interval, trajectories are calculated for each launch date and further subdivided into flight-time ranges graduated into 2-day increments. Launch dates and approximate flight-time ranges for this volume are as follows (only trajectories requiring *vis viva* geocentric energies of less than 40 km^2/sec^2 are printed out within a given range). Launch dates (1964) and flight-time range (days), respectively, are: Oct. 1 to Oct. 29, 240–398; Oct. 30 to Nov. 8, 180–418; Nov. 9 to Nov. 23, 160–422; and Nov. 24 to Dec. 26, 140–434. In essence, this volume presents the results of extensive machine computations of three-dimensional ballistic interplanetary trajectories. The analytical model used to represent these trajectories is based upon two-body, inverse-square, force-field mechanics. I.v.L.

N64-29515* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THEORY OF SPACE FLIGHT AND ADAPTIVE GUIDANCE Status Report No. 2
W. E. Miner 14 Feb. 1963 52 p refs
(NASA-TM-X-51924; MTP-AERO-63-15) OTS: $5.60 ph

An organized effort is presently being conducted for the purpose of advancing the theory of space flight and adaptive guidance, and for developing and improving the techniques of their application to present and potential Saturn missions. The report summarizes and comments on the results obtained to date in celestial mechanics, calculus of variations, and large computer exploitation. Author

N64-29518* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
THREE-DIMENSIONAL GUIDANCE EQUATIONS FOR QUASI-OPTIMUM SPACE MANEUVERS
Donald J. Jezewski [1964] 28 p refs Presented at the 15th Intern. Astron. Cong., Warsaw, 7–12 Sep. 1964
(NASA-TM-X-51926) OTS: $2.60 ph

An analytical technique has been derived by operating on a set of linearized two-body equations with the classical calculus of variations to determine a guidance law. A three-dimensional case, in which aerodynamic forces are neglected, is treated. The solution differs from that derived previously in that a continuous constant thrust rather than a constant acceleration is assumed. The equations are first reduced to a flat-body set in two dimensions to determine what approximations may be made and still obtain a valid solution for a class of launch and landing trajectories. By integration, three simultaneous transcendental equations in three unknowns can be derived from this set of equations. The downrange coordinate was assumed to be free at the terminal time. Trajectories resulting from this set are compared with optimum trajectories to determine which errors are present and which terms, deleted by the flat-body approximation, are the principal contributors to the error. Author

N64-29607 General Dynamics/Fort Worth, Tex.
EARTH-MARS-EARTH BALLISTIC TRAJECTORY DATA, 1975–1986. VOLUME I: DESCRIPTION AND APPLICATION OF DATA
S. W. Wilson, Jr. 5 Jun. 1964 133 p refs
(FZM-4163-1)

This volume contains a detailed description of the trajectory parameters whose numerical values are mapped in the computer output sheets of Volume II–VII. The mission-map format and the advantages it offers to the interplanetary mission analyst are discussed. A system is described for heliocentric trajectory and mission classification, which is particularly suited to the mission-map format, and some of the more important characteristics of certain general types of Earth–Mars–Earth missions are briefly discussed. Also included is a short discussion of the variation of mission characteristics from one synodic period to another. Author

N64-29728* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
AN AUTOMATED MODEL FOR PREDICTING AEROSPACE DENSITY BETWEEN 200 AND 60,000 KILOMETERS ABOVE THE SURFACE OF THE EARTH
Robert E. Smith 10 Jun. 1964 35 p refs
(NASA-TM-X-53062) OTS: $3.60 ph

This paper describes the derivation of a computer routine for predicting the vertical distribution of aerospace density in the terrestrial space environment above the surface of the earth. Solar activity, geomagnetic storm, diurnal heating, latitude, and the earth's orbital eccentricity effects are included in this model. Densities can be predicted for any time through December 1962. Author

N64-29729* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
CHARACTERISTIC FEATURES OF SOME PERIODIC ORBITS IN THE RESTRICTED THREE BODY PROBLEM
Wilton E. Causey 17 Aug. 1964 64 p refs
(NASA-TM-X-53108) OTS: $6.60 ph

Earth–moon orbits are presented that, when referred to a rotating coordinate system, return periodically to their original

set of state variables. Information concerning the period of the orbit, time spent in the region between earth and moon, close approach distance to the moon, and closest approach distance to the earth is given for various families of periodic orbits. These orbits have periods of 1 to 4 months, and they have at least one perpendicular crossing of the earth–moon line on the back side of the moon. Author

N64-29796 Aerospace Corp., El Segundo, Calif. Electronics Div.
STUDIES RELATIVE TO RENDEZVOUS BETWEEN CIRCULAR ORBITS
B. H. Billik and H. L. Roth 22 Jun. 1964 80 p refs
(Contract AF 04(695)-269)
(TDR-269(4550-10)-7; SSD-TDR-64-41; AD-604751)

In-plane rendezvous from an inner circular parking orbit to an outer circular target orbit is studied. Comparisons are made between the Hohmann and the bi-elliptic transfer techniques. Parking in either bi-elliptic transfer ellipse is considered as a means of reducing the necessary bi-elliptic velocity expenditure at the expense of transfer time. The bi-elliptic transfer is shown to be useful only in a limited band of orbital radii ratio values. This band decreases as the number of parking revolutions increases. The semitangential transfer (with and without parking) is considered as a means of further reducing the transfer time, often at the expense of an increase in velocity requirement. Each of the above transfer techniques is then analyzed for velocity limited maneuvers. Author

N64-29797 Aerospace Corp., El Segundo, Calif. Electronics Div.
EQUATIONS OF MOTION FOR A GRAVITY-GRADIENT STABILIZED SATELLITE SUBJECT TO AMBIENT PERTURBING FORCES AND TORQUES
V. Chobotov 1 May 1964 60 p refs
(Contract AF 04(695)-269)
(TDR-269(4540-70)-2; SSD-TDR-64-114; AD-605297)

The three translational and three rotational equations of motion for a gravity-gradient stabilized satellite are derived. The effects of the earth oblateness, magnetic field, solar radiation, aerodynamic drag, and any control forces are included. The usefulness of vector, matrix, and dyadic notation for derivation of equations is demonstrated, and the results are reduced to scalar form wherever possible. Author

N64-29863 RAND Corp., Santa Monica, Calif.
ECLIPSE OBSERVATIONS FROM A JET AIRCRAFT
G. E. Kocher Jul. 1964 21 p refs
(RM-4226-RC; AD-603212)

This memorandum describes an experiment in which high-altitude observations of a total solar eclipse were made from a modified jet airliner. A program of photographic photometry of the outer corona was prepared. Photographs in two broad spectral ranges were obtained with two cameras operated during totality. The cameras were manually guided to ±3 minutes of arc during exposures ranging from 1/10 sec to 10 sec. Although good pictures were obtained of the inner corona, the photometry was not successful, primarily due to the unavoidable substitution of a Plexiglas window for the glass optical flat originally planned. However, it was demonstrated that very cheap manual guiding can provide suitable pointing accuracy for many experiments, and that under similar conditions it should be possible to guide manually to ±4 minutes of arc over the entire duration of totality. Author

N64-29892 Centre National d'Etudes Spatiales, Paris (France)
DEFINITION OF STANDARDS FOR SPACE RESEARCH [DEFINITION DES REPERES POUR LA RECHERCHE SPATIALE]
S. Bernhard-Lemarié, R. Simon de Kergunic, and J.-C. Lespès Jul. 1964 24 p refs In FRENCH
(CNES-NT-1)

The National Center for Space Research (Le Centre National d'Etudes Spatiales) recommends the use of standardized notations relative to variables and designations of satellite or rocket positions, and presents standardized notations for the following: (1) the position of bodies—satellite, rocket, celestial, and observation stations; (2) designations relative to a satellite or rocket (principal axes of inertia, local orbital axes); (3) designations relative to a satellite orbit; (4) designations relative to the earth; (5) astronomical angles; (6) terrestrial angles; (7) angles designating the position of a satellite relative to its orbit; (8) satellite orbital angles; and (9) matrices of rotation with application to Euler's angles, to the change from an absolute designation to a local designation, and to the rotation of space. I.v.L.

N64-30039 RAND Corp., Santa Monica, Calif.
DISCRETIZATION IN GALACTIC STRUCTURE AND COSMOLOGY
T. Y. Thomas Jul. 1964 57 p refs
(RM-3990-RC; AD-602328)

The basic assumption, which is referred to as the principle of similarity, expresses in invariant differential form the well-known geometrical concept of the similarity transformation and leads to metrics that appear to be somewhat more general than those in common use in cosmological theory. This principle also leads to the introduction of a wave function ψ, which can be interpreted as directly representative of the deviations from a statical metric that occur within the galaxian world tubes or on their boundaries as the result of the action of extraneous influences. Certain discretization effects are required for the existence of solutions of the wave equation satisfied by the function ψ under steady-state conditions; this is discussed briefly for the special case of spherical galaxies. Author

N64-30076* National Aeronautics and Space Administration, Washington, D.C.
OPTIMAL COPLANAR FLIGHT BETWEEN ORBITS [OPTIMAL'NYY KOMPLANARNYY POLET MEZHDU ORBITAMI]
S. N. Kirpichnikov Sep. 1964 32 p refs Transl. into ENGLISH from Vestn. Leningr. Univ., Ser. Mat., Mekh. i Astron. (Leningrad), v. 30, no. 1, 1964 p 130–141
(NASA-TT-F-221) OTS: $0.75

Presented is a study of coplanar flight between given orbits, achieved by means of thrust of minimal characteristic velocity. This minimizes fuel consumption. It is assumed that in all the orbits—initial, final, and intermediate—the motion is Keplerian. An analysis is made of both the case of flight without allowance for flight time and the case of flight with corrections made for specific flight times in all three orbits. Author

N64-30137 System Development Corp., Santa Monica, Calif.
A SATELLITE ORBIT PREDICTION PROGRAM
John Staudhammer 25 May 1964 95 p refs
(SP-1665; AD-443771)

A computer model is described for predicting satellite positions from a set of initial data. The model is simple and is a mechanization of a set of equations borrowed from celestial

mechanics. The original purpose of the computer model was to provide a teaching vehicle for classical celestial mechanics and computer program design. In its present form the model can serve for the generation of two-body reference orbits for near-earth elliptical satellite trajectories. The program has been checked carefully and is believed to contain no serious logic or syntax errors. I.v.L.

N64-30163 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
g = 0: CURRENT PROBLEMS IN BIOASTRONAUTICS
P. Octavian and D. Cristian 10 Jul. 1964 12 p Transl. into ENGLISH from Stiinta Si Tehnica (Bucharest), v. 15, no. 1, 1963 p 19–21
(FTD-TT-64-556/1+2+3+4; AD-603334)

The nature of and conduct in weightlessness in space, the necessity for sterilization of lunar and interplanetary spaceships, and the physiological problems encountered by radar observers in tracking space flights are discussed in the report. A.W.

N64-30185 Naval Weapons Lab., Dahlgren, Va. Computation and Analysis Lab.
A COMPUTER PROGRAM TO COMPUTE ORBITAL ELEMENTS FROM POSITION AND VELOCITY OR POSITION AND VELOCITY FROM ORBITAL ELEMENTS
Mary B. Palen May 1964 17 p
(K-37/64; AD-602832) OTS: $1.00

This report describes a program used to compute the orbital elements: a(semimajor axis), e(eccentricity), I(inclination), /(mean anomaly), g(argument of perigee) and h(right ascension) when given x, y, z, $\dot{x}$, $\dot{y}$, and $\dot{z}$ (inertial coordinates of position and velocity). Or, when given the above elements, it will compute position and velocity. The method described herein is especially useful for computing orbital elements for special cases of low eccentricities and inclinations. Author

30 SPACE VEHICLES

Includes launch vehicle-spacecraft combinations; missile systems; operating problems; safety devices; and stability and control. *For boosters and launch vehicles see*: 31 Space Vehicles (Launch Vehicles). *For related information see*: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N64-29335* National Aeronautics and Space Administration, Washington, D.C.
NASA TO LAUNCH SEVENTH SATURN I IN APOLLO TEST News Release No. 64-228
13 Sep. 1964 29 p Available from the Scientific and Technical Information Division

The Saturn I (SA-7) vehicle systems are described. According to NASA, the vehicle will be flight tested with a "dummy" Apollo spacecraft attached to the upper stages. Objectives of the flight are to test the propulsion, structural, guidance, and flight-control systems; to test the Apollo configuration, the compatibility of the launch vehicle and spacecraft, and the spacecraft launch escape system. D.E.R.

N64-29664 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
TROLLEYBUS LINE IN SPACE
V. Tobolev 4 Jun. 1964 6 p Transl. into ENGLISH from Znaniye-Sila (Moscow), no. 2, 1964 p 47–48
(FTD-TT-64-620/1; AD-602337)

Electrified rails, aligned in space by small engines, are proposed as a method of guiding ion engine rockets into space. The small engines, as well as the rocket, are supplied with energy from earth by wires in a manner similar to trolleybuses. Further in space, the rails and small engines are electrified by solar power stations. The thrust of the small engines is controlled by radio, and a change in rocket direction is accomplished by changing the thrust of the small engines. Similar rails are set up in the vicinity of the target planet for the return trip. M.P.G.

31 SPACE VEHICLES (LAUNCH VEHICLES)

Includes boosters; clustered rockets; and multistage rockets. *For propulsion engines see*: 27 Propulsion. *For manned space capsules, satellites, and sounding rockets and space probes see*: 32 Space Vehicles (Spacecraft). *For launch vehicle-spacecraft combinations see*: 30 Space Vehicles. *For related information see*: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N64-29327 General Dynamics/Astronautics, San Diego, Calif.
LAUNCH VEHICLE RE-ENTRY FRAGMENT STUDY Final Report
K. H. Meyer and H. H. Hunt Kirtland AFB, N. Mex., AF Weapons Lab., Jun. 1964 72 p refs
(Contract AF 29(601)-5980; ARPA Order 70-62)
(WL-TDR-64-39; AD-442767)

Microcraters on fragments (from Mercury Atlas Launch vehicles) recovered in Africa and South America were thoroughly analyzed. Spectrographic and electron-probe analyses indicated that the craters (or other impact damage) could not have been the result of collision with micrometeoroids or atmospheric dust, but that the craters were caused by impacts from sprays of particles that resulted when material ablated from the adapter and/or nose section and struck projections on the tank assembly as it broke up during reentry. Computer analysis of the trajectory, combined with the locations in which the fragments were found, indicated that after initial breakup (at 370,000 feet), at least one large section remained intact until it reached about 260,000 feet. While material ablating from leading edges is a hazard to vehicles reentering the earth's atmosphere, appropriate design could eliminate this hazard. Author

N64-29552* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
RANGER BLOCK III LAUNCH CONSTRAINTS PLANNING DOCUMENT, ADDENDUM NO. 2
E. S. Travers 20 Jan. 1964 41 p refs
(Contract NAS7-100)
(NASA-CR-56799; EPD-130) OTS: $4.60 ph

This addendum updates previously presented launch constraints with respect to range safety, launch vehicle, and tracking and telemetry coverage, and presents launch window designs for each day of the third launch period—January 30 to February 6, 1964. The launch constraints given are considered to be the best current estimates; final detailed launch constraints will be issued on a daily basis during the period. The assumption is made that the spacecraft–launch-vehicle system is functioning properly, and consideration is not given to launch constraints that result from system failures. This document, together with the "Test and Operations Plan" and the "Atlas–Agena Working Group Launch Test Directive," constitutes a handbook for establishing a go or no-go decision during the countdown. D.S.G.

N64-29595 Chrysler Corp., Huntsville, Ala. Space Div.
LOCAL PRESSURE COEFFICIENTS ON SATURN IB, S-IB STAGE, TAIL SHROUD. DESIGN CRITERIA
J. F. Thompson, W. L. Francis, and R. H. Ross 10 Mar. 1964 13 p
(TB-AE-64-10)

An analysis was conducted to determine the local pressure coefficient distribution over the Saturn IB, S-1B stage, tail shroud, including the 60-degree fairing for use as preliminary design information. The pressure coefficients are based on the nominal trajectory, for the maximum payload, to the 105 n.m.i. orbit with the 200K engine. The results of this analysis, which will be submitted to MSFC for concurrence as design criteria, represent the current best estimate of the tail barrel local-pressure distributions, and should be used as preliminary design information. Since the external pressure coefficients are only a function of the configuration and free-stream Mach number, these values are applicable for any trajectory of this Saturn IB geometric configuration. The internal pressure coefficients of the tail shroud are a dependent function of the trajectory, however, and these will have to be corrected for any trajectory variation. I.v.L.

32 SPACE VEHICLES (SPACECRAFT)

Includes manned space capsules; satellites; and sounding rockets and space probes. *For boosters and launch vehicles see*: 31 Space Vehicles (Launch Vehicles). *For launch vehicle-spacecraft combinations see*: 30 Space Vehicles. *For related information see*: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N64-29228* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SATELLITE SITUATION REPORT, VOLUME 4, NUMBER 12
30 Jun. 1964 13 p
(NASA-TM-X-51920; X-533-63-1) OTS: $1.60 ph

Data are presented on objects in orbit from launch dates 1958 through 1964. Data are also given for decayed objects launched in 1964. I.v.L.

N64-29334* National Aeronautics and Space Administration, Washington, D.C.
NASA TO LAUNCH FIRST ORBITING GEOPHYSICAL OBSERVATORY News Release No. 64–213
30 Aug. 1964 41 p Available from The Scientific and Technical Information Division

In a news release by NASA, the features of the OGO-A satellite, its objectives and experiments, launch-vehicle statistics, and the OGO launch sequence are presented. D.E.R.

N64-29388* National Aeronautics and Space Administration, Washington, D.C.
PRESENTATION ON RANGER VII TO MEMBERS OF CONGRESS
5 Aug. 1964 35 p Available from the Scientific and Technical Information Division

Slide-illustrated reports were presented to Congress on Ranger VII by Mr. Harris M. Schurmeier, Ranger Project Manager of the Jet Propulsion Laboratory, Pasadena, California, and by Mr. P. Kuiper, Director of the Lunar and Planetary Division, University of Arizona. Mr. Schurmeier's report described the mission profile, which included a brief description of the spacecraft, what the spacecraft had to do, and how well it did it. In addition, he referred to the worldwide, real team operation that was involved in making this project a success. Dr. Kuiper interpreted several photographs taken of the lunar surface by the Ranger's cameras. I.v.L.

N64-29553* Stanford Research Inst., Menlo Park, Calif.
TECHNICAL PROBLEMS ASSOCIATED WITH COMMERCIAL COMMUNICATION SATELLITES. PART E: ECONOMIC ASPECTS OF SATELLITE COMMUNICATION SYSTEMS Final Report
Ernest D. Wenrick Nov. 1963 36 p refs
(Contract NASr-49(08))
(NASA-CR-58031) OTS: $3.60 ph

The purpose of this report is to examine the economic feasibility of commercial communication satellites. The examination was based largely on the results of a survey of available literature. The following conclusions were drawn: (1) No accurate method for forecasting overseas telecommunication traffic exists at this time. (2) A period of several years will elapse from the initial operational date of a satellite communication system until the system becomes profitable. (3) Ultimate preference, on economic grounds, will be accorded the system utilizing synchronous-orbit satellites. (4) The key to system costs is reliability, as expressed by the probability of a successful launch and by the mean time to failure. (5) Voice communications will take up the bulk of overseas circuits (between 80% and 95%) for at least the next decade. (6) Television is unlikely to be a major factor in the demand for overseas communication circuits. I.v.L.

N64-29572* Goodyear Aerospace Corp., Akron, Ohio
PHOTOMETRIC MEASUREMENTS OF SURFACE CHARACTERISTICS OF ECHO I SATELLITE Final Report
Richard H. Emmons et al 19 Jun. 1964 87 p refs
(Contract NAS1-3114)
(NASA-CR-58290; GER-11648) OTS: $8.10 ph

The results and techniques of a program that exploited the realistic test specimen represented by the nearly 4-year-old Echo I Satellite by measuring its present surface characteristics are described. For this purpose, the classical astronomical techniques of photometric measurement were employed by developing and utilizing equipment and procedures for the measurement of satellite-reflected light. The data obtained were analyzed to derive and evaluate the desired characteristics. Changes in specularity, reflectance degradation, overall size, and present shape of the Echo I satellite are derived by this means. Photographic and photoelectric photometry were used simultaneously. Author

N64-29580 White Sands Missile Range, N. Mex.
METEOROLOGICAL ROCKET NETWORK FIRINGS. VOLUME XVII DECEMBER 1962 FIRINGS Data Report
1964 211 p
(IRIG-109-62; AD-443494)

The Meteorological Rocket Network (MRN) combines the investigative efforts of a number of meteorological organizations engaged in upper atmospheric studies. This report contains wind and temperature measurements collected from all available MRN firings during the month of December 1962, plus the radiosonde observations nearest the time of firing (providing they are within ± 6 hours). The types of rockets and their temperature and wind-sensor instrumentation systems are identified on the charts, presented, and identified by code on the corresponding data sheets. I.v.L.

N64-29601* National Aeronautics and Space Administration, Washington, D.C.
IONOSPHERE EXPLORER SATELLITE News Release No. 64-207
24 Aug. 1964 22 p Available from the Scientific and Technical Information Division

According to NASA, there will be launched, no earlier than August 25, 1964, a 97-pound, cone-shaped ionosphere-monitoring satellite designed to explore irregularities in the earth's ionosphere. Ionosphere Explorer A, nicknamed Topsi, will be launched into a circular, near-polar, 620-mile-high orbit by a four-stage Scout rocket from the Pacific Missile Range, Point Arguello, California. It will collect and transmit information on the structure of the upper ionosphere—the layer of ionized gases that surrounds the earth and acts as an electrified mirror for long-range radio communications. It is hoped that information obtained will help to explain such events as the "spread-F phenomenon," which consists of large patches of irregularities in the F-2 region that are frequently observed at night in the polar and equatorial regions. Other mysteries to be explored include "radio-wave ducting," a process in which radio energy is guided along the earth's magnetic field; the relation of density formation with magnetic disturbances; and the degree of "connectedness" in the F-2 region between the Northern and Southern Hemispheres. I.v.L.

N64-30072 Lockheed-California Co., Burbank
DEVELOPMENT OF A POWER SPECTRAL GUST DESIGN PROCEDURE FOR CIVIL AIRCRAFT Monthly Progress Report, Jun. 1–30, 1964
F. M. Hoblit and N. Paul 8 Jul. 1964 55 p refs
(Contract FA-WA-4768)
(MPR-4)

Work at this stage of the program involves primarily detailed dynamic analyses. Considerable effort was expended to assure that, on a static basis, the ten-degree-of-freedom program duplicates loads obtained by the accepted static-load methods. For this purpose, ten-degree-of-freedom loads were obtained for both the 749 and the Electra for a maneuver condition obtained by introducing a low-frequency elevator oscillation. The resulting loads are not sensitive to the exact frequency chosen, as long as it is below that of the airplane short-period mode. Experience in applying the ten-degree-of-freedom analysis to the determination of dynamic gust loads on the P-3A indicated that, to account adequately for the effect of static aeroelastic deflection on the spanwise load distribution and on the gust load factor, it was necessary to replace the second dynamic wing torsion mode by a static aeroelastic deflection shape. In addition, it was found that nacelle response above 4 cps could not be adequately represented by the ten-degree-of-freedom program. I.v.L.

N64-30154 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
RESERVE OF STRENGTH
A. Nikolayev 17 Jul. 1964 10 p Transl. into ENGLISH from Kryl'ya Rodiny (USSR), no. 5, 1963 p 3–5
(FTD-TT-64-160/1+2; AD-603326)

This is a firsthand account by the cosmonaut of the Soviet spaceship Vostok-3. He describes his preflight training, his reactions to the actual space flight, and the value of the flight to scientific knowledge in general and to space activities in particular. A.W.

33 STRESSES AND LOADS

Includes fatigue; vibration; flutter; and structural tests. *For thermal stress see*: 13 Heat Transfer and Thermodynamics. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 34 Structural Design.

N64-29024 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE TEMPERATURE CALCULATION OF AN ORTHOTROPIC PLATE WITH TRANSVERSE SHEAR TAKEN INTO CONSIDERATION
S. M. Durgar'yan 19 Jun. 1963 14 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow), no. 6, 1962 p 154–160
(FTD-TT-63-529/1+2+4; AD-414626)

A rectangular orthotropic plate of constant thickness h, referred to rectangular cartesian coordinates, is examined. The coordinate plane xoy is combined with the average plane of an undeformed plate, and the coordinate axes are directed along the principal directions of elasticity of the plate material. The coordinate origin is set at one of the apexes of the plate. The deformation factors E_i, μ_{ij}, G_{ij}, and the thermal coefficients of expansion are considered as given functions of temperature T, changing according to a known law. Here, E_i and β_i are, respectively, Young's modulus and the thermal coefficient of expansion along the coordinate axis i; the Poisson coefficient μ_{ij} characterizes the contraction in the direction j during expansion in the direction i; the shear modulus G_{ij} characterizes the change in angle between the principal directions i and j. It is assumed that the relative deformation throughout the plate is conditioned by free thermal expansion. Using Ambartsumyan's theory as a basis, it is considered that the tangential stresses τ_{xz} and τ_{yz} can be represented as $\tau_{xz} = f_1(z)$, $\phi(x,y)$, $\tau_{yz} = f_2(z)\psi(x,y)$, where $\phi(x,y)$ and $\psi(x,y)$ are unknown functions, $f_i(z)$ are given functions that characterize the law of change of tangential stresses τ_{xz} and τ_{xy} throughout the plate; and $f_i(\pm h/2) = 0$. I.v.L.

N64-29027 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
VIBRATIONS AND STABILITY OF A RIBBED CYLINDRICAL SHELL IN A FLOW OF COMPRESSIBLE LIQUID
B. M. Bublik 27 Jun. 1963 7 p ref Transl. into ENGLISH from Dopovidi Akad. Nauk Ukr. RSR(Kiev), no. 2 1963 p 178–183
(FTD-TT-63-647/1; AD-414131)

Certain questions are considered concerning the vibration and stability of a closed cylindrical elastic shell, reinforced

by elastic ribs (rigidity ribs), that is in a nonviscous flow of a compressible fluid. Equations are derived for the natural frequencies of this elastic system, and the critical rate of liquid flow is determined. For the sake of simplicity, only normal shell vibrations are discussed. The rigidity ribs are considered as being discretely distributed over the shell. I.v.L.

N64-29224* Ryan Aeronautical Co., San Diego, Calif.
EXPLOSIVE FORMING STRESS ANALYSIS, PHASE II
R. W. Johnson 21 Feb. 1964 46 p refs
(Contract NAS8-5129)
(NASA-CR-58365; Rept.-64B021) OTS: $4.60 ph

An explosive forming tank is analyzed by the impulse method developed in Phase I and is found adequate for Phase III use. Notable is the fact that no "factor of ten," or some such number as reported by others, is resorted to in the new tank-analysis method. Subscaled-sized plates, except for thickness, were explosively formed. Discussions of explosives, impact phenomena, and stress wave propagation are included. Author

N64-29251 Aerospace Industries Assn. of America, Inc., Washington, D.C. Research and Technology Div.
PROCEEDINGS OF SYMPOSIUM ON AEROELASTIC AND DYNAMIC MODELING TECHNOLOGY
Mar. 1, 1964 785 p refs Symp. Held at Dayton, Ohio, 23–25 Sep. 1963
(RTD-TDR-63-4197, Pt. I; AD-434797)

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12. ON THE USE OF DYNAMIC MODELS FOR STUDYING LAUNCH VEHICLE BUFFET AND GROUND-WIND LOADS P. W. Hanson and G. W. Jones, Jr. (NASA) p 333–387 refs (See N64-29262 21-33)

13. SIMULATION OF ORBITAL MOORING OF GEMINI AND AGENA VEHICLES BY MEANS OF DYNAMICALLY SCALED MODELS R. K. Nolting (McDonnell Aircraft Corp.) p 389–415 (See N64-29263 21-33)

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15. DEVELOPMENT OF DYNAMIC MODEL ROTOR BLADES FOR HIGH SPEED HELICOPTER RESEARCH E. A. Frandenburgh and E. F. Kiely (United Aircraft Corp.) p 431–507 refs (See N64-29265 21-33)

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17. HAYSTACK ANTENNA 1/15 SCALE MODEL PROGRAM R. V. Bennett (North Am. Aviation, Inc.) p 551–571 (See N64-29267 21-33)

18. SCIENTIFIC MODELING FOR PHOTOMECHANICS G. Gerard and H. Becker (Allied Res. Assoc., Inc.) p 573–608 refs (See N64-29268 21-33)

19. THE USE OF MODELS FOR CONTROL OF SONICALLY INDUCED VIBRATIONS M. Bernstein and R. Goss (Grumman Aircraft Eng. Corp.) p 609–647 refs (See N64-29269 21-33)

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21. IMPLICATIONS OF PRACTICAL RE-ENTRY STRUCTURES FOR DYNAMIC MODEL SIMULATION S. A. La Favor, C. E. Lemley, and P. B. Tucker (McDonnell Aircraft Corp.) p 673–701 refs (See N64-29271 21-33)

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24. AIRFRAME STRUCTURAL TESTING—"WHERE DO WE GO FROM FULL SCALE?" H. B. Lowndes and R. L. Cavanagh (AFSC) p 763–773 refs (See N64-29274 21-33)

N64-29252 Air Force Systems Command, Wright-Patterson AFB, Ohio AF Flight Dynamic Lab.
DYNAMIC MODELING—ITS PAST AND FUTURE
Dale E. Cooley and Robert F. Cook *In* Aerospace Ind. Assoc. of Am. Proc. of Symp. on Aeroelastic and Dynamic Modeling Technol. Mar. 1964 p 13–48 refs (See N64-29251 21-33)

This paper covers the historical background of dynamic modeling and the evolution to the current state-of-the-art of modeling methods and uses. A review and discussion of recent research efforts dealing with various modeling problems, including flutter models for inflatable structures, high angles-of-attack, high temperature environments, vibration, and sonic fatigue prediction are presented. Also included are remarks concerning future requirements and problem areas where research is needed to assure the availability of adequate modeling technology for the potential dynamic problems of advanced flight vehicles. Author

N64-29253 Martin Co., Denver, Colo.
ANALYSIS OF SIMILITUDE REQUIREMENTS AND SCALING LAWS FOR TRANSONIC BUFFETING
H. C. Peterson and A. A. Ezra *In* Aerospace Ind. Assoc. of Am. Proc. of Symp. on Aeroelastic and Dynamic Modeling Technol. Mar. 1964 p 49–79 refs (See N64-29251 21-33)

This paper derives the similitude requirements and the corresponding scaling laws for small-scale experimental work and describes the different experimental approaches that can be used to circumvent the practical difficulties of fulfilling all the similitude requirements. Scaling laws that apply to scale model tests to determine transonic buffeting excitation are derived by direct application of the Buckingham Pi Theorem. The difficulties arising from inability to provide exact similitude are pointed out. The theory of distorted scale models is reviewed. Author

N64-29254 Southwest Research Inst., San Antonio, Tex.
DYNAMIC STRUCTURAL MODELING USING DISSIMILAR MATERIALS
Gale E. Nevill, Jr *In* Aerospace Ind. Assoc. of Am. Proc. of Symp. on Aeroelastic and Dynamic Modeling Technol. Mar. 1964 p 81–96 refs (See N64-29251 21-33)
(Contract AF 29(601)-4923)

Presented are an analysis of the general similitude requirements for the modeling of dynamic response of aerospace structures utilizing dissimilar materials, and an investigation of the problems associated with meeting these requirements. Model tests involving the elastic-plastic response of impulsively loaded beams and plates made of relatively weak and dense lead-loaded plastic are described, and their results are compared with independent full-scale results for aluminum. Author

N64-29255 Giannini Controls Corp., Berwyn, Pa. Astromechanics Research Div.
APPLICATION OF AEROELASTIC MODELING TECHNIQUES TO THE DETERMINATION OF STRUCTURAL LOADS AND STABILITY AND CONTROL DYNAMIC CHARACTERISTICS
J. A. Hill and X. A. Gikas *In* Aerospace Ind. Assoc. of Am. Proc. of Symp. on Aeroelastic and Dynamic Modeling Technol. Mar. 1964 p 129–158 refs (See N64-29251 21-23)

This paper considers the application of aeroelastic modeling techniques to the determination of structural loads and stability and control characteristics. Specifically, the paper deals with considerations for development of static and dynamic flexible wind-tunnel models to be used to measure structural loads and stability and control characteristics. The need for development in these facets of modeling is indicated by reviewing the present technological status of aerodynamic wind-tunnel simulation and testing. The technical considerations required for these modeling extensions are divided into seven areas: similitude, model, mounting system, control system, sensors, data transmission, and data handling. The requirements and problems pertinent to each of these areas are defined. It is concluded that these extensions of aeroelastic modeling techniques are feasible and desirable from both technical and economic points of view. Author

N64-29256 General Dynamics/Astronautics, San Diego, Calif.
DYNAMIC TESTING TECHNIQUES FOR A WIND TUNNEL MODEL
G. L. Kugler *In* Aerospace Ind. Assoc. of Am. Proc. of Symp. on Aeroelastic and Dynamic Modeling Technol. Mar. 1964 p 159–167 refs (See N64-29251 21-33)

This paper presents testing methods and techniques that were used to define the structural dynamic characteristics of wind-tunnel models. These models and techniques were developed for a wind-tunnel test program on ground wind induced oscillatory loads on Atlas space launch vehicles. Models of nine different space launch vehicles, utilizing the Atlas space booster, were tested. The 1/15 scale aluminum model was so constructed as to facilitate the simulation of various propellant loads with the resultant varying dynamic parameters. The structural dynamic characteristics of interest were the damping factor of the first bending mode, the first elastic mode shape, the first mode frequency, and load deflection information. Discussion will include the model excitation method, vibration measurements, model instrumentation, and certain model construction details. Author

N64-29257* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A NEW "FREE-FLIGHT" MOUNT SYSTEM FOR HIGH-SPEED WIND-TUNNEL FLUTTER MODELS
Wilmer H. Reed, III and Frank T. Abbott, Jr. *In* Aerospace Ind. Assoc. of Am. Proc. of Symp. on Aeroelastic and Dynamic Modeling Technol. Mar. 1964 p 169–206 refs (See N64-29251 21-33)

Wind-tunnel investigations of aeroelastic models often require that rigid body as well as elastic modes of the test article be simulated. In effect, the mount system must allow the model to be "flown" in the test section and have negligible aerodynamic interference at transonic Mach numbers. Such a system has been developed for flutter and gust response investigations on complete models in the transonic dynamics tunnel. The system consists of a pair of cables that pass through pulleys in the model and run upstream and downstream of the test section in mutually perpendicular planes. Stability and natural frequencies of the cable-supported model are controlled by the preload tension in a spring in one of the cables. The paper describes some evaluation tests and presents a stability analysis, which shows the influence of various parameters that govern dynamic characteristics of the system. Author

N64-29258 Massachusetts Inst. of Tech., Cambridge
CONSTRUCTION AND TESTING TECHNIQUES OF INFLATABLE FLUTTER MODELS
J. R. Martucelli, F. H. Durgin, and R. B. Mc Callum *In* Aerospace Ind. Assoc. of Am. Proc. of Symp. on Aeroelastic and Dynamic Modeling Technol. Mar. 1964 p 207–248 (See N64-29251 21-33)
(Contract AF 33(657)-8568)

A method is presented of constructing inflatable Airmat-type models, which are suitable for use as wind-tunnel-flutter models. The techniques used in static and dynamic model test are also presented, along with the results of some tests on a series of sharply swept back, inflatable delta wings. The vibration mode shapes of a delta wing as determined by use of mirrors, mounted on the model, are presented. The importance of shear- and bending-type deformations are presented by comparing the results of static and dynamic tests with theoretical calculations. Some experimental results on the properties of the model surface material are also included. Author

N64-29259* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SUPPORT SYSTEMS AND EXCITATION TECHNIQUES FOR DYNAMIC MODELS OF SPACE VEHICLE STRUCTURES

Robert W. Herr and Huey D. Carden *In* Aerospace Ind. Assoc. of Am. Proc. of Symp. on Aeroelastic and Dynamic Modeling Technol. Mar. 1964 p 249–277 (See N64-29251 21-33)

This paper discusses several techniques for supporting and exciting dynamic models of space vehicle structures to study their dynamic properties such as natural frequencies, mode shapes, damping, and response. Particular attention is given to a unique support harness for vertical support of missile-like structures with minimum lateral restraint. Included in the discussion of vibration exciters is an air shaker that is particularly useful for excitation of the natural modes of light structures and for those having thin skins such as encountered on dynamic models of space vehicles. Author

N64-29260 McDonnell Aircraft Corp., St. Louis, Mo.
DIAGNOSIS OF FLUTTER MODEL RESPONSE USING TIME CORRELATION TECHNIQUES
R. J. Werdes and M. A. Ferman *In* Aerospace Ind. Assoc. of Am. Proc. of Symp. on Aeroelastic and Dynamic Modeling Technol. Mar. 1964 p 279–298 refs (See N64-29251 21-33)

A unique method for analyzing flutter model time histories is presented. The method, which yields repeatable results, utilizes as the diagnostic parameter the continuous analog evaluation of the aerodynamic work imparted to the model in a flutter mode per unit time, i.e., the aerodynamic power. The aerodynamic power function is readily evaluated for the case of wing bending-torsion flutter in terms of the average running cross correlation of wing bending and torsion responses sensed by strain gages. Typical experimental results are presented for swept wings tested in transonic blowdown tunnels. Applications to systems involving more degrees of freedom are presented. Author

N64-29261 Dynamic Devices, Inc., Dayton
COMPUTER VS MODEL
Lee S. Wasserman and Walter J. Mykytow, AFSC *In* Aerospace Ind. Assoc. of Am. Proc. of Symp. on Aeroelastic and Dynamic Modeling Technol. Mar. 1964 p 301–331 refs (See N64-29251 21-33)

Problems of airplane and space vehicles that must be analyzed thoroughly from the standpoint of dynamics are summarized. Tools available for the solution of such problems include the digital and analog electronic computers and mechanical analogs such as dynamically similar models. Practical difficulties in the fabrication of dynamically similar models, limitations in the availability of test environments and basic effects of scale on dynamic phenomena require the use of certain assumptions in the design, fabrication, and testing of dynamically similar models. Recommended procedures involving the use of both models and analytical techniques are outlined for the solution of specific problems in dynamics for airplane and space vehicles. Author

N64-29262* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ON THE USE OF DYNAMIC MODELS FOR STUDYING LAUNCH VEHICLE BUFFET AND GROUND-WIND LOADS
Perry W. Hanson and George W. Jones, Jr. *In* Aerospace Ind. Assoc. of Am. Proc. of Symp. on Aeroelastic and Dynamic Modeling Technol. Mar. 1964 p 333–387 refs (See N64-29251 21-23)

The complex nature of the random aerodynamic input forces associated with transonic buffet and ground winds leads to difficulty in analytical treatment of the response of launch vehicles to these important loading conditions. The application of aeroelastically scaled models in the wind tunnel as a mechanical analog of the mathematically complex problem requiring solution is described. Scaling relationships involved in this approach are developed, and some checks on their validity are presented. Model design and support techniques are discussed, and some typical results are given. Some problems arising from the increased size of launch vehicles are discussed. Author

N64-29263 McDonnell Aircraft Corp., St. Louis, Mo.
SIMULATION OF ORBITAL MOORING OF GEMINI AND AGENA VEHICLES BY MEANS OF DYNAMICALLY SCALED MODELS
R. K. Nolting *In* Aerospace Ind. Assoc. of Am. Proc. of Symp. on Aeroelastic and Dynamic Modeling Technol. Mar. 1964 p 389–415 (See N64-29251 21-33)

The 1/4-scale dynamic model mooring test has effectively simulated the orbital mooring of a Gemini spacecraft with an Agena booster. The orbital condition of the vehicles was realistically duplicated by special suspension systems. The model confirmed the basic design of the full-scale mooring system; i.e., no undesirable modes of collapse were found; the mooring loads were within the design values; the importance of high return stroke damping was demonstrated by the excessive bounce-off characteristics shown; reasonable boundaries of free-body latching were determined. Author

N64-29264 Douglas Aircraft Co., Inc., Santa Monica, Calif.
DYNAMIC MODELING OF FUEL SLOSH
E. D. Calkin and C. K. Webb *In* Aerospace Ind. Assoc. of Am. Proc. of Symp. on Aeroelastic and Dynamic Modeling Technol. Mar. 1964 p 417–430 refs (See N64-29251 21-33)

The mathematical development of an equivalent spring mass model is given, along with necessary assumptions, for two specific cases—the right circular cylinder and the sphere. The approaches to a definition of the properties of tanks with approximately these shapes (the Saturn S-IV liquid hydrogen and liquid oxygen tanks) in terms of these simple shapes are then shown. The results of extensive testing of scale models of the tanks with liquids are then used to define the most suitable approach. Scaling parameters include damping as well as geometric scaling. A short discussion of the properties of damping baffles shows that important effects other than damping are sometimes introduced. Author

N64-29265 United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft
DEVELOPMENT OF DYNAMIC MODEL ROTOR BLADES FOR HIGH SPEED HELICOPTER RESEARCH
Evan A. Fradenburgh and Edmond F. Kiely *In* Aerospace Ind. Assoc. of Am. Proc. of Symp. on Aeroelastic and Dynamic Modeling Technol. Mar. 1964 p 431–507 refs (See N64-29251 21-33)

The development of scale-model helicopter rotor blades that are dynamically and structurally similar to full-scale blades is presented in terms of the need for such models, problems associated with the construction of the blades, testing experience, and useful information gained by this research. Experimental results obtained include data on performance, blade motions, elastic deformations, steady and vibratory blade stresses, and rotor vibration phenomena. In addition to experience with blades designed to operate at full-scale tip

speeds and Mach numbers, modified blades have been developed to provide full-scale Froude numbers and, thus, proper gravity effects, as well as allowing higher simulated forward speeds. These blades allow experimental research on rotary wing aircraft in the 400-knot category. Author

N64-29266 Northrop Corp., Hawthorne, Calif.
DYNAMIC MODELS FOR LOW CYCLE FATIGUE
W. H. Roberts and K. Walker *In* Aerospace Ind. Assoc. of Am. Proc. of Symp. on Aeroelastic and Dynamic Modeling Technol. Mar. 1964 p 511–550 refs (See N64-29251 21-33)

Aeroelastic and dynamic models are a practical way to improve aerospace and vehicle safety and reliability while providing significant economies in resources and reduction in full-scale ground and flight testing. Progress in applying the models to fatigue problems of two types, specimens and complex structures, is presented. The nature of present fatigue problems is explored—in particular, the link between fatigue and dynamic loads of both high and low frequency. For low cycle fatigue, the models may be applied in real time or in scaled time. The accuracy required for dynamic response is very high, but that required for fatigue scaling is higher still. Principal advantage of the models is their capability to handle all aspects of the static and dynamic loads simultaneously, including thermal loads. Author

N64-29267 North American Aviation, Inc., Columbus, Ohio
HAYSTACK ANTENNA 1/15 SCALE MODEL PROGRAM
Richard V. Bennett *In* Aerospace Ind. Assoc. of Am. Proc. of Symp. on Aeroelastic and Dynamic Modeling Technol. Mar. 1964 p 551–571 (See N64-29251 21-33)

This paper describes the design, construction, and experimental test program for a 1/15-scale static and dynamic elastic model of the 120-ft-diam haystack antenna. The experimental phases of this program consisted of a rigging demonstration, influence coefficient tests, and ground vibration tests. The program objectives were to demonstrate the feasibility of the proposed procedure for rigging the prototype antenna, to verify the analytical program used for predicting deadweight deflections of the prototype antenna, and to provide qualitative information concerning the vibration characteristics of the prototype antenna. All objectives were satisfactorily accomplished. Author

N64-29268 Allied Research Associates, Inc., Concord, Mass.
SCIENTIFIC MODELLING FOR PHOTOMECHANICS
Herbert Becker and George Gerard *In* Aerospace Ind. Assoc. of Am. Proc. of Symp. on Aeroelastic and Dynamic Modeling Technol. Mar. 1964 p 573–608 refs (See N64-29251 21-33)

Three fields of photomechanics are discussed to show the effort required to generate models for scientific exploration of these fields. The approaches center about the fundamental principle that the proper design of an experiment requires scientific design of the model to be investigated. Examples are chosen from photothermoelasticity, photoviscoelasticity, and strobelasticity. These three fields are applicable to investigations of structural, thermal, and dynamic problems in rockets and reentry vehicles. Therefore, in addition to examples of basic problems, demonstrations of practical interest are included. These depict thermal stresses in a box beam, stresses in a case bonded viscoelastic rocket grain, and the effect of impact on a reentry vehicle. Author

N64-29269 Grumman Aircraft Engineering Corp., Bethpage, N.Y.
THE USE OF MODELS FOR CONTROL OF SONICALLY INDUCED VIBRATION
M. Bernstein and R. Gross *In* Aerospace Ind. Assoc. of Am. Proc. of Symp. on Aeroelastic and Dynamic Modeling Technol. Mar. 1964 p 609–647 refs (See N64-29251 21-33)

A half-scale dynamically similar model of a nonuniformly stiffened fuselage structure of slightly varying cross section was designed, constructed, and tested to obtain data on the response of the full-scale structure to propeller-noise excitation. This approach was chosen as the logical compromise between the cost of a full-scale accuracy of practicable analytical methods. The model was used to determine how the natural frequencies of the structure might be varied, if necessary, and to investigate means for reducing internal noise and vibration levels. As an indication of the accuracy of practicable analytical methods when applied to relatively complex, realistic structures, a comparison was made between the experimental vibration characteristics and the mode shapes and frequencies computed for an "equivalent" uniform cylinder and for a ring cross section with stiffeners included. Author

N64-29270 General Dynamics/Pomona, Calif.
VIBRATION TESTING DURING HIGH HEAT RATES
K. L. Mc Intyre *In* Aerospace Ind. Assoc. of Am. Proc. of Symp. on Aeroelastic and Dynamic Modeling Technol. Mar. 1964 p 649–669 refs (See N64-29251 21-33)

Test facilities, techniques, and results are presented for vibration model tests of a thin, very low aspect ratio wing subjected to transient heating. The two independent closed control loops are described that are used to track and excite the modes, and to obtain the desired temperature time history. Time-history data are presented for frequency and shape of five wing vibration modes subjected to heat rates as high as 300° F/sec, maximum temperatures of 650° F, and geometric temperature gradients as high as 110° F/in. Some comparisons of theoretical to test results are made. Author

N64-29271 McDonnell Aircraft Corp., St. Louis, Mo. System Technology Div.
IMPLICATIONS OF PRACTICAL RE-ENTRY STRUCTURES FOR DYNAMIC MODEL SIMULATION
S. A. La Favor, C. E. Lemley, and P. B. Tucker *In* Aerospace Ind. Assoc. of Am. Proc. of Symp. on Aeroelastic and Dynamic Modeling Technol. Mar. 1964 p 673–701 refs (See N64-29251 21-33)

The unique considerations associated with the application of aerothermoelastic scaling laws in the design, construction, and testing of flutter models for reentry glide vehicles are discussed. A brief review of the scaling laws is presented in order to reemphasize the point that they cannot be completely satisfied for other than the case of full-scale testing of flight type hardware. This is followed by a discussion of four structural concepts that have been devised to provide acceptable structures for use in the reentry environment. These concepts are reviewed with respect to predicting the mechanism of potential aerothermoelastic problems and to establishing the possibility of relaxing some of the restrictions of the aerothermoelastic scaling laws. Author

N64-29272 Boeing Co., Seattle, Wash Aero-Space Div.
DESIGN AND CONSTRUCTION CONSIDERATIONS OF A TRANSONIC-SUPERSONIC AEROELASTIC FLUTTER MODEL OF X-20A

Verner P. Diehl *In* Aerospace Ind. Assoc. of Am. Proc. of Symp. on Aeroelastic and Dynamic Modeling Technol. Mar. 1964 p 703–720 refs (See N64-29251 21-33)

The application of existing and available techniques and materials to the design of a flutter model of a Dyna-Soar (X-20A) configuration is discussed. Solutions to the specific problems of simulating the structure scale weight, stiffness, and aerodynamic characteristics are presented. Author

N64-29273 Chance Vought Corp., Dallas, Tex.
DYNAMIC MODEL TESTING OF THE XC-142A AIRCRAFT
A. L. Head, Jr. and W. D. Smith *In* Aerospace Ind. Assoc. of Am. Proc. of Symp. on Aeroelastic and Dynamic Modeling Technol. Mar. 1964 p 723–762 refs (See N64-29251 21-33)

This paper presents some of the results of the dynamic model tests of the XC-142A aircraft. Of particular interest are the testing techniques associated with propeller whirl flutter. The model incorporates simulation of the engine mount dynamics, of the propeller dynamics, and of the shafting dynamics in addition to the regular structural dynamics. The model is used to check mount failure conditions with respect to flutter and to check dynamic loads with respect to propeller unbalance. Author

N64-29274 Air Force Systems Command, Wright-Patterson AFB, Ohio AF Flight Dynamics Lab.
AIRFRAME STRUCTURAL TESTING—"WHERE DO WE GO FROM FULL SCALE?"
A. B. Lowndes, Jr. and R. L. Cavanagh *In* Aerospace Ind. Assoc. of Am. Proc. of Symp. on Aeroelastic and Dynamic Modeling Technol. Mar. 1964 p 763–773 (See N64-29251 21-33)

Current airframe structural integrity test requirements are reviewed, and the necessity for full-scale rather than component testing is briefly discussed. Trends in test complexity and cost are presented, which show that as environmental simulation parameters become more demanding, large aerospace vehicle full-scale testing becomes economically prohibitive. The application of component testing or modeling techniques as a solution to this problem is discussed, and suggestions for needed research are presented. Author

N64-29307 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
CONTRIBUTION TO THE TECHNIQUE OF PHOTOELASTICITY
M. Biot (Calif. Inst. of Tech.) 28 Jul. 1964 6 p Transl. into ENGLISH from Ann. Soc. Sci. Bruxelles, vol. 53, 1963 p 13–15 (RSIC-233; AD-444427)

A simple photoelastic technique is described. The difference of the principal stresses is obtained by photography of the model under stress in monochromatic light. This gives lines of equal differences in the principal stresses. The two photographic pictures make it possible to easily determine the complete elastic state by applying the following statements. The difference of the principal stresses and their orientation and the forces that act on the edge of the model are known. This means that the elastic state is completely known at the edge. Very frequently one of the principal stresses even equals zero. Moreover, it is known that the sum of the principal stresses, $p + q$, obeys the Laplace equation $\Delta (p + q) = 0$. Since the sum, $p + q$, is known on the edge, it is completely determined inside the model. Its calculation is then reduced to the solution of the potential problem. This problem may be solved experimentally in a very simple way by one of the many electrical or mechanical analogs that are subject to the potential equation (soap films, rubber membranes). I.v.L.

N64-29352 Atomics International, Canoga Park, Calif.
STRESS AND ELEVATED TEMPERATURE FATIGUE CHARACTERISTICS OF LARGE BELLOWS
R. A. Winborne 15 Sep. 1964 88 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-9762) OTS: $2.00

Ten large 20-in.-diam 304 stainless steel bellows were tested to or near fatigue failure; nine in 1,200° F sodium, and one in air at 70° F. The data indicated that, at 1,200° F, fatigue life of axially deflected large convolute-shaped bellows, without internal pressure influence, was mainly determined by bellows geometry, and was associated with a factor μ, used frequently in asymptotic shell theory of convolute-shaped bellows, where:

$$\mu = \frac{a^2\sqrt{12(1-\nu^2)}}{\bar{R}t},$$

a = bellows convolution radius,
$\bar{R}$ = average bellows radius,
t = bellows wall thickness, and
ν = Poisson's ratio.

On a log–log chart, there appeared to be a linear relationship between $1/\mu$ and cycles-to-failure of axially deflected, large convolute-shaped bellows at 1,200° F. Conventional high-μ ($\mu \geq 2$) bellows always failed at, or near, the welded junctures of the bellows-to-pipe ends where stresses were highest. With stresses very uniformly distributed over their profiles, low-μ ($\mu = 0.25$) bellows appeared to be relatively insensitive to stress raising influences. Author

N64-29355 Canadian Armament Research and Development Establishment, Valcartier
THE EFFECTS OF WIND ON SOUNDING ROCKETS
R. C. Brereton Jul. 1964 43 p refs
(CARDE-TN-1613/64)

A theory to account for the effects of wind on a sounding rocket has been developed. A simplified computational procedure has also been developed that permits prediction of the final direction of the velocity vector to within 3° (90% probability). It should be emphasized that the assumptions embodied in the theory restrict the applicability of this method to trajectories that are near the vertical and to vehicles that have no asymmetries and are not rolling. The available data indicate that for the Black Brant I and II vehicles the theory is adequate for normally encountered winds, launch angles, and roll rates. The assumptions of the theory may not be adequate for other vehicles having different configurations. Author

N64-29362 Experimental Inst. of Light Metals, Milan (Italy)
FATIGUE BEHAVIOUR OF THE Ti-Al 6-V 4 ALLOY AT NORMAL AND HETERONORMAL TEMPERATURES
C. Panseri and L. Mori [1963] 30 p Presented at the 3rd ICAF-AGARD Symp. on Aeronautical Fatigue, Rome, 23–25 Apr. 1963
(ICAF-251)

Reported are the characteristics of rotating-beam fatigue tests for alloy Ti-Al 6-V 4 carried out at room, low (−196° C), and elevated (300° to 500° C) temperatures. The material exhibited remarkable endurance at temperatures of −196° C (= 104 kg/mm^2) and at elevated temperatures. The notch influence on fatigue characteristics and the mean notch sensitivity were determined. Also illustrated are the static, elastic, and notch characteristics recorded at various testing temperatures from −196° to 700° C. Author

N64-29373 Naval Applied Science Lab., Brooklyn, N.Y. Material Sciences Div.
THE NASL NOTCHED FLAT COMPRESSION TEST FOR FILAMENT WOUND MATERIALS. REINFORCED PLASTICS FOR DEEP SUBMERGENCE AND OTHER HIGH STRENGTH APPLICATIONS
N. Fried and M. Silvergleit 28 May 1964 22 p
(PK-5; AD-602155)

The notched flat method for determining compressive strength of filament-wound materials is described. Data are presented for a series of tests, in which a number of different methods of grip construction were employed, indicating good reproducibility, with an overall coefficient of variation of 4.9%. For a material of 2:1 orthogonal construction, with S-glass reinforcement, an average compressive strength value of 157,800 psi was obtained in the stronger ("2") direction. This value is within 5% of the average value reported for tests on cylindrical specimens, of similar construction, tested hydrostatically. Very recent data for a material of superior quality, tested by the notched flat method, gave an average value of compressive strength in the "2" direction of 178,000 psi, with an individual high of 192,800 psi. Author

N64-29402* Southwest Research Inst., San Antonio, Tex.
LIQUID SLOSHING IN SPHERICAL TANKS
H. Norman Abramson, Wen-Hwa Chu, and Luis R. Garza 15 Mar. 1962 29 p refs
(Contract NAS8-1555)
(NASA-CR-58652; TR-2) OTS: $2.60 ph

Experimental data on the forced vibration characteristics of partially filled unbaffled and baffled spherical tanks are presented. For the unbaffled tank, comparisons are made with previously measured natural frequencies and with predictions of the Budiansky analysis. For the baffled tanks, comparisons are made with the force response predicted from an equivalent mechanical model. The basic predictions of the Budiansky theory were confirmed, particularly for liquid natural frequency; however, the force response is quite dependent on the magnitude of the excitation amplitude. From this, it is concluded that large amplitude liquid-free-surface motions are more easily excited and appear to be of more importance in modifying the total force response in spherical tanks than in cylindrical tanks. Perforated ring baffles oriented horizontally appear to be quite effective in providing force amplitude damping, with significant lowering of the fundamental resonant frequency. No baffling is apparently required for large liquid depths. P.V.E.

N64-29418 CTS Corp., Elkhart, Ind. Research and Development Div.
PRODUCTION ENGINEERING MEASURE FOR SUBMINIATURE, TRANSISTOR TYPE POTENTIOMETERS Quarterly Progress Report, 1 Jan.–31 Mar. 1964
C. L. Holmes and D. C. Kinsey [1964] 17 p
(Contract DA-36-039-SC-85976)
(QPR-11; AD-601867)

One thousand and eight hundred preproduction samples of two styles (flat mount and bushing mount) of subminiature, transistor-type potentiometers were fabricated and submitted to preproduction testing. All failures, on visual and mechanical inspection, were due to the stop torque test. Failures also occurred on the rotational life test and on the moisture-resistance test. Minor specification changes have been requested on stop torque and rotational life. These deviations are believed to be realistic, and will result in a highly reliable 3/8-in.-diameter cermet resistor potentiometer. Twenty-four hundred 25,000-ohm bushing mount potentiometers being evaluated on the 10,000-hour load-life reliability study have passed 3,000 hours (7,200,000 unit hours) of testing with very satisfactory results. I.v.L.

N64-29427 Technical Operations Research, Burlington, Mass.
EFFECTS OF HYPERVELOCITY IMPACTS ON MATERIALS
V. E. Scherrer, M. Beran, H. Stevens, and R. W. O'Neil Wright-Patterson AFB, Ohio, AF Mater. Lab., Jun. 1964 57 p refs
(Contract AF 33(616)-8423)
(ML-TDR-64-161; AD-601880)

Reliable diagnostic techniques were developed to measure the mass and velocity of hypervelocity particles projected by an exploding-foil gun. Velocities were increased from 20,000 fps to better than 35,000 fps as a result of improved gun design and modifications to the energy storage system, including the installation of an electrically triggered switching system. The electro-optical 6-frame Kerr cell camera was also evaluated. A program to measure the electrical parameters of the system and to correlate them with photographic data was instituted, and a theoretical model for the partition of impact energy of a hypervelocity particle was begun. Author

N64-29438 Marine Engineering Lab., Annapolis, Md.
RESTRAINT CRACKING TECHNIQUE FOR USE IN SIMULATED WELD THERMAL CYCLING STUDIES
W. G. Schreitz 26 Jun. 1964 28 p refs
(MEL-90-64; AD-602101) OTS: $1.00

Weld hot-cracking tendencies of five experimental HY-80 steels were studied with the time–temperature cycling apparatus developed at Rensselaer Polytechnic Institute. Restraint was introduced by restricting the longitudinal expansion and contraction of 0.25-in.-diameter test specimens subjected to thermal cycles corresponding to various welding conditions. The restrained specimens were monitored during cycling by an ultrasonic flaw detector to record the temperature of crack initiation. Cracking was detected during the cooling portion of the thermal cycles only, and, generally, within the temperature range of 2,400° to 2,000° F. Crack initiation appeared to be controlled by both the degree of restraint and the peak temperature. Cracking tendencies of the steels were related to sulphur content by this technique. Author

N64-29448 Watertown Arsenal Labs., Mass.
FLOW STRESS-STRAIN RELATIONSHIPS IN TENSION TESTS OF STEEL
John Nunes Apr. 1963 14 p refs
(WAL-TR-834.2/10; AD-407267) OTS: $0.50

From the observation that the tensile flow stress curve remains reasonably linear once local necking occurs, a useful relationship between the uncorrected flow stress curve and the corrected flow stress curve is derived utilizing Bridgman's correction formula. The slopes of these curves, m_1 (corrected flow stress) and m (uncorrected flow stress), are linear strain-hardening indices. They are analytically and experimentally shown to be related by a constant factor that appears to be 0.5. It is possible to approximate the corrected flow stress curve and the linear strain hardening factor m_1 employing the relationships proposed here. It is further shown that a useful linear strain hardening index can be evaluated at a necking strain of 1.0 using the relationships of $m = 0.4\sigma_1$ (the uncorrected flow stress at a necking strain of 1.0). Author

N64-29556* Dynatech Corp., Cambridge, Mass.
FREE VIBRATIONS OF THE PRESTRESSED TOROIDAL MEMBRANE Report No. 474
Atis A. Liepins 22 May 1964 59 p refs
(Contracts NASw-600; NASw-881)
(NASA-CR-58532) OTS: $5.60 ph

A numerical analysis of the free vibrations of the prestressed circular toroidal membrane is presented. Frequency curves and mode shapes are displayed and compared with those of the prestressed circular string and those obtained from classical ring theory. The effect of prestress on frequencies is shown. Author

N64-29561 Pennsylvania State U., University Park
THEORETICAL ANALYSIS OF INTERNAL BLAST WAVES IN SPHERES Quarterly Progress Report, Jan. 1–Mar. 31, 1964
Norman Davids 31 Mar. 1964 3 p
(Contract DA-36-034-ORD-3576-RD)
(QPR-9; AD-602887)

This project is concerned with a theoretical study on the propagation of waves, produced by an explosion, in a spherical cavity in metals. The purpose of such a study is to help find reliable criteria for extrapolating internal blast-loading behavior to larger spherical containers. This study is being conducted concurrently with an experimental investigation on 7-in. and 10-in. spheres. Research includes spherical elastic waves, spherical plastic waves, shock waves and detonation waves, and mathematical theory. I.v.L.

N64-29646 North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
INVESTIGATION OF STRUCTURAL IMPLICATIONS OF METEOROID IMPACT Technical Documentary Report, Apr. 1962–Jun. 1964
F. C. Posever and C. N. Scully Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Jul. 1964 139 p refs
(Contract AF 33(657)-8159)
(SID-64-656; FDL-TDR-64-96; AD-602512) OTS: $5.00

An experimental hypervelocity impact program involving quasi-infinite, single- and multiple-sheet target configurations is described, and results are presented. The program provides an initial screening phase of shielding concepts applicable to the design of spacecraft structures. Quasi-infinite target data are correlated with several existing penetration equations. The program was performed in order to extend experimental data to velocities in the range of 25,000 to 48,000 fps. The Mark IV hypervelocity projectile accelerator was used to provide the data. Author

N64-29680 Lockheed Missiles and Space Co., Sunnyvale, Calif.
MATHEMATICS: SHELL WITH EDGE LOADS OF RAPID VARIATION II Technical Report
C. R. Steele Nov. 1963 48 p refs
(Rept.-6-90-63-84)

The previously obtained solution for the thin elastic shell with edge loads whose wavelength is smaller than the shell radii of curvature is shown to provide a transition from thin-shell behavior to flat-plate behavior. The general character of the interior stress distribution is discussed. An examination is made of the properties of the stiffness matrix, which give the edge stresses due to prescribed edge displacements, and the properties of the inverse (flexibility) matrix. A solution is provided for the paradox of the shell of negative curvature with shear-beam supported edges, for which the membrane theory indicates a spectrum of edge loads that produce infinite stress. Author

N64-29688* New York U., N.Y. Courant Inst. of Mathematical Sciences
NON-LINEAR THEORY FOR THE DEFORMATION OF PRESTRESSED CIRCULAR PLATES AND RINGS
Chester B. Sensenig Jun. 1964 38 p refs
(Grant NsG-412; Contract Nonr-285(42))
(NASA-CR-58572; IMM-NYU-326) OTS: $3.60 ph

A comparison is made between the plane stress results of the linear and nonlinear theories of elasticity. In addition, the circular plate and ring are derived, into which the prestressed circular plate and ring, respectively, deform when hydrostatic pressures are applied to their curved lateral surfaces. The manner in which the stress normal to a plane through the axis, as computed from the nonlinear theory, reduces to that of the linear theory, when the prestressing and applied hydrostatic pressures are small, is observed. In addition to imposing the equilibrium equations and using the stress–strain laws to obtain boundary conditions, it is required that the Jacobian of the deformation be positive, except in isolated points or curves, for both the linear and nonlinear treatments. It is shown that the discrepancy between the linear and nonlinear theory results is due to the approximation $r^{\epsilon} = 1 + \epsilon \log r$. I.v.L.

N64-29704* Catholic U. of America, Washington, D.C.
MEASUREMENT OF THE COMPLEX SHEAR MODULUS OF A LINEARLY VISCOELASTIC MATERIAL
J. H. Baltrukonis, D. S. Blomquist, and E. B. Magrab May 1964 52 p refs
(Grant NsG-125-61)
(NASA-CR-58238; TR-5) OTS: $5.60 ph

A detailed description is presented of an experimental system intended to measure the complex shear modulus of homogeneous, isotropic, and linearly viscoelastic materials. The test is based on the torsional oscillations of a circular cylindrical sample of finite length. The test and data reduction procedures are described. A FORTRAN listing of the data reduction computer program is included. Actual measurements are presented on a sample of filled polyvinylchloride. Master curves of the shear storage modulus and shear loss tangent are plotted by making use of the time–temperature shifting principle. Author

N64-29754 General Electric Co., San Jose, Calif. Vallecitos Atomic Lab.
STRAIN-CYCLE PHENOMENA IN THIN-WALL TUBING
Myrow B. Reynolds Washington, AEC, 30 Jan. 1964 30 p refs
(Contract AT(04-3)-189)
(GEAP-4462) OTS: $0.50

The service life of a nuclear reactor fuel element is related to the ability of its metallic cladding to accommodate severe local plastic strains caused by fuel expansion or external coolant pressure. A technique has been developed for subjecting samples of thin-wall tubing to cyclic plastic strains similar to those experienced in reactor service. By applying gas pressure, the thin tubular specimen is alternately expanded and contracted between rigid concentric mandrels until failure occurs as indicated by gas leakage. Relative cyclic strain range is determined by mandrel dimensions, specimen diameter, and specimen wall thickness. At larger strain ranges, deformation occurs by reverse bending rather than by simple

tension and compression. These tests have been made at 1,300° F on specimens of Hastelloy-X, Inconel-600, Incoloy-800, and Type-304 stainless steel; the last two in-reactor as well as in the laboratory. Author

N64-29757 Joint Publications Research Service, Washington, D.C.
THE COLLISION OF DEFORMABLE BODIES AND MODELING OF SUCH A PROCESS, III [O PROTSESSE SOUDARENIYA DEFORMIRUYEMYKH TEL I YEGO MODELIROVANII, III]
L. V. Belyakov, F. F. Vitman, and N. A. Zlatin 22 Sep. 1964 9 p refs Transl. into ENGLISH from Zh. Tekhn. Fiz. (Moscow), v. 34, no. 3, Mar. 1964 p 519–522
(JPRS-26499; TT-64-41757) OTS: $1.00

Direct measurements reported in the paper prove that, with the modeling criteria used, the collision forces of deformable bodies can be modeled according to the final results, as well as to the running values of deformations and forces. Four equations are formulated for the measurements and proof of the hypothesis. A.W.

N64-29852 Air Force Systems Command, Wright-Patterson AFB, Ohio AF Materials Lab.
APPLYING ENGINEERING MECHANICS SOLUTIONS TO DEFLECTIONS OF STATICALLY LOADED COPLANAR FIBERS Technical Report, Sep. 1963–Feb. 1964
James M. Whitney May 1964 42 p refs
(ML-TDR-64-118; AD-60304)

Since fibers and fiber bundles form the elements of a fibrous structure, it is necessary to investigate the mechanical behavior of fibers subjected to static loading. This report demonstrates the application of engineering mechanics to the problem of textile fiber deflection under various initial shapes and load conditions. By assuming an idealized fiber it was possible to apply thin circular rod theory to the analysis of fiber deflections. For straight fibers and circular fibers subjected to various coplanar static loadings, deflections were found from the solution of linear and nonlinear differential equations. Linear equations were applied in the case of small deflections, and rather complex nonlinear equations were applied in the case of large deflections. Author

N64-29920 Rensselaer Polytechnic Inst., Troy, N.Y.
ELASTIC VIBRATIONS OF PARABOLOIDAL SHELLS OF REVOLUTION
W. H. Hoppmann II, M. I. Cohen, and V. X. Kunukkasseril Apr. 1963 20 p refs
(Contract DA-30-115-509-ORD-912)
(AD-402926)

Observations are made concerning the equations of motion that include both flexural and membrane stresses, those that relate to flexural and membrane stresses for shallow shells, and those that apply to membrane stresses only. Results are also presented for an extensive experimental study of the vibrations of two models of thin paraboloidal shells. Author

N64-29933 Stanford U., Calif.
IMPERFECTIONS, A MAIN CONTRIBUTOR TO SCATTER IN EXPERIMENTAL VALUES OF BUCKLING LOAD
W. H. Horton and S. C. Durham May 1964 33 p refs
(Contract DA-44-177-AMC-115(T))
(TRECOM-TR-64-31; AD-604033)

This paper develops a novel approach for testing cylindrical shells. A method of buckle restriction by an internal mandrel located at a distance of one wall thickness from the surface of the shell is used. By means of this device, it is possible to buckle the shell elastically until the shell is completely filled with buckles. It is shown that the variation of the rate of change in number of buckles as a function of the applied load follows a gaussian distribution. The mode of the gaussian curve is located at a load level that agrees very closely with the critical buckling load computed from the classic formula. The evidence presented is substantial support for the small displacement theory and is a strong indication that buckling takes place first at the weakest section of the shell and that the amount of buckling is a function of the area of weakness. Author

N64-29935 Brown U., Providence, R.I. Div. of Applied Mathematics
WAVE PROPAGATION IN THE LINEAR THEORY OF VISCOELASTICITY
George M. C. Fisher and Morton E. Gurtin Aug. 1964 16 p refs
(Contract Nonr-562(25))
(TR-28; AD-604661)

Herrera and Gurtin have shown that, in the linear theory of viscoelasticity, the speed of propagation U of an acceleration wave is a solution of the eigenvalue problem $(G_{ijkl}(0)n_in_l - \rho U^2\delta_{ik})\beta_k = 0$. (1.1). Here $G_{ijkl}(0)$ is the initial value of the relaxation function $G_{ijkl}(t)$; ρ is the mass density; and n is a unit vector in the direction of the propagation of the wave. This paper shows that the eigenvalue problem (1.1) governs not only the speed of propagation of acceleration waves but also the propagation speeds of shocks and all higher-order waves. I.v.L.

N64-29943 Technical Operations Research, Burlington, Mass.
THE EFFECTS OF SPRAY PARTICLES FROM THE PENETRATION OF THIN TARGETS BY HYPERVELOCITY PARTICLES Final Report
R. W. O'Neil and V. E. Scherrer 20 Mar. 1964 30 p
(Contracts AF 33(657)-10615; AF 33(616)-8423)
(APL-TDR-64-60; AD-602706)

When a thin bumper target is impacted by a hypervelocity particle, a spray of particles is produced. Data are presented on the penetration of these spray particles into a witness plate for various bumper and witness plate materials, spacings, and bumper thicknesses. The exploding-foil projection technique and associated diagnostics are also described. Author

N64-30000 Polytechnic Inst. of Brooklyn, N.Y.
A FURTHER NOTE ON THE CREEP ANALYSIS OF ANNULAR PLATES
B. Venkatraman, Sharad A. Patel, and Michael R. Birnbaum May 1964 18 p
(Contract AF 49(638)-1360)
(PIBAL-695; AFOSR-64-1039; AD-604467)

On the basis of a creep law formulated in terms of the Tresca criterion, the creep bending of annular plates was analyzed by Venkatraman and Patel. The present note considers the solutions presented by them for plates with sufficiently small holes and sufficiently large holes and quantitatively defines the transition from one solution to the other. The note presents the complete solution (not properly covered in the reference) to the problem of an annular plate with its inner edge free and outer edge clamped and under uniform lateral pressure. Author

N64-30099* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECT OF STORE PITCH FLEXIBILITY ON FLUTTER CHARACTERISTICS OF A WING-STORAGE CONFIGURATION AT MACH NUMBERS NEAR 0.85
Lou S. Young and Charles L. Ruhlin Washington, NASA, Sep. 1964 35 p refs
(NASA-TN-D-2479) OTS: $1.00

The flutter characteristics of a cantilevered wing carrying a pylon-mounted external store were obtained with the store-attachment pitch flexibility varied systematically over a wide range. The store was mounted at the 75.5% semispan position on an untapered wing of aspect ratio 4 and 45° of sweepback. The store-pylon mass was roughly the same as the wing panel mass. Two chordwise locations of the store center of gravity were investigated. Limited tests were made to indicate the effects of the aerodynamic loads caused by the store and of Mach number variation from about 0.8 to 1.3. The results of the investigation are compared with the experimental results for the wing without stores. Author

N64-30104* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ELASTIC CONSTANTS FOR BENDING AND TWISTING OF CORRUGATION-STIFFENED PANELS
W. Jefferson Stroud Washington, NASA, Dec. 1963 44 p refs
(NASA-TR-R-166) OTS: $1.25

Theoretical formulas for five orthotropic elastic constants are presented for panels consisting of a corrugated plate attached to one side of a flat plate. The formulas are in terms of the dimensions of the corrugation pattern for the general case of different corrugation and cover-plate materials. The constants are the bending stiffnesses parallel to and normal to the corrugation direction, the twisting stiffness, and the Poisson ratios associated with bending. Bending stiffnesses measured on panels with three different corrugation patterns, and twisting stiffnesses measured on panels with two different patterns, compare favorably with the theoretical results. Author

N64-30165 Aberdeen Proving Ground, Md. Ballistic Research Labs.
TORSIONAL VIBRATIONS OF A HOLLOW VISCOELASTIC CYLINDER
William Goldberg Jun. 1964 46 p refs
(BRL-MEMO-1570; AD-603854)

The motion of a hollow viscoelastic cylinder with outer cylindrical surface fixed, and inner surface bonded to a mass and subjected to a step function of torque is analyzed. The method used is an extension of the engineering vibration analysis of normal modes and normal coordinates. In analogy to elastic analysis, the characteristic numbers associated with these modes depend only upon the boundary conditions and not on the mechanical properties of the cylinder. The characteristic frequencies, however, do depend on the material properties. Numerical calculations were performed on the BRLESC digital computer using two different high-order differential operator representations of the shear modulus of polyisobutylene. The calculations demonstrate the effect of different model representations of the shear modulus and the effect of the attached mass on the transient response of the cylinder. Author

N64-30203 Drexel Inst. of Tech., Philadelphia, Pa.
ATTENUATION OF THE STRONG PLANE SHOCK PRODUCED IN A SOLID BY HYPERVELOCITY IMPACT
Pei Chi Chou, Harbans S. Sidhu, and Lawrence J. Zajac Feb. 1964 52 p refs
(Contract DA-36-034-ORD-3672-RD)
(DIT-125-5; AD-439665)

The attenuation of strong plane shocks in solids produced by hypervelocity impact is studied, and two parametric equations are developed that describe the path of the shock front in the x,t plane. These parametric equations were derived by considering the entropy change across the decaying shock and by assuming that the characteristic lines behind the shock are straight lines. The equation of state is approximated by simple Hugoniot and isentrope equations. The same problem is also solved graphically by a stepwise characteristic method. A comparison of the graphical and analytical results shows that the simplifying assumptions made for the analytical solution are valid for both weak and strong shocks. Author

34 STRUCTURAL DESIGN

Includes structural elements; and weight analysis. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 33 Stresses and Loads.

N64-29295 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
APPROXIMATE DESIGN OF PROTECTIVE METEOR SHIELDS
L. S. Bezgin and M. I. Ivashchenko *In its* News of the Acad. of Sci. of the USSR, Technol. Sect.: Mech. and Machine Bldg. 16 Jun. 1964 p 27–33 refs (See N64-29292 21-23)

Increasing wall thickness is the simplest way to protect space equipment from the dangers of meteors. An approximate method is given in equations for calculating the upper limit for the thickness of a screen and housing of a meteor shield. A.W.

N64-29359* Lockheed Missiles and Space Co., Sunnyvale, Calif.
NOZZLE DESIGN CRITERIA FOR A MACH 4 LOW-DENSITY FACILITY USING CARBON DIOXIDE—WITH COMMENTS ON MACH 3, 6, 9 AND 12 NOZZLES Technical Report, 31 Dec. 1963–31 Jul. 1964
T. M. Cunningham 31 Jul. 1964 54 p refs
(Contract NAS8-11144)
(NASA-CR-58314; H-64-003) OTS: $5.60 ph

The effects of specific heat ratio on Mach number, boundary-layer thickness, displacement thickness, and the radius of the uniform core were determined parametrically. Nozzle design criteria were then determined by plotting the variation of specific heat with temperature onto a family of constant specific heat ratio–Mach number curves. A design curve for Mach number versus nozzle station was found from which all other nozzle characteristics could be defined. Design curves are presented for all nozzles studied. Two phase flow probability is shown for nozzles with Mach numbers greater than 4 at the exit. Author

N64-29587 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
MAGNETIC ARMOR PROTECTS AGAINST COSMIC SHOWERS

V. Zaytsev 15 Aug. 1963 10 p Transl. into ENGLISH from Tekhn. Molodezhi (Moscow), no. 3, 1963 p 35–37
(FTD-TT-63-760/1+2; AD-420762)

The feasibility and advantages of shielding spacecraft from radiation by using superconducting solenoids to create a magnetic field around the spacecraft are discussed. One of the previous problems associated with superconducting magnets—the disrupting effect of the ordinary magnetic fields generated by the strong currents in the superconductor—has been overcome by the development of niobium and other alloys, which withstand high magnetic fields without the loss of superconductivity. The rocket engine itself could be used as a magnetohydrodynamic generator to provide the initial energy input to the solenoid. The problem of instantaneous release of the entire stored energy by accidental disruption of part of the winding could be overcome by winding the coils in individual sections so that each one of them would carry only a part of the current. Although many problems remain to be solved, magnetic shilding is considered to be the only answer to radiation protection for interplanetary flight. M.P.G.

N64-29614 Telecomputing Corp., San Diego, Calif.
FILAMENT-WOUND PRESSURE VESSELS Final Report, 5 Sep. 1962–5 Dec. 1963
Frank Wilson Dec. 1963 101 p refs
(Contract AF 34(601)-14053)
(AD-600215) OTS: $4.00

Glass filament-wound bottles have been subject to fatigue failures because of the stresses imposed on the relatively weak resin binder system. By redesigning the spherical bottle to a cylindrical shape having isotensoid dome ends, and by using the MultiShell method of fabrication, a weight savings of 10% to 15% coupled with an increase in ultimate burst pressures of 15% to 30% has resulted. This redesigning takes advantage of the unidirectional strength characteristics of the glass filament and reduces the stress on the resin binder system to an acceptable level. Author

N64-29623 Naval Ordnance Test Station, China Lake, Calif. Underwater Ordnance Dept.
PARTIAL-PENETRATION WELDED CONNECTIONS FOR ALUMINUM COMPRESSION MEMBERS
James H. Jennison and Robert S. Gill Apr. 1964 30 p refs
(NAVWEPS-8495; NOTS-TP-3468; AD-602361) OTS: $2.00

For aluminum compression members or shell structures that cannot conveniently be heat treated after welding, partial-penetration welding retains much of the original compressive strength of the structure and is a potentially useful idea for the design of deep-submergence vehicles. Three sets of 1- by 2- by 6-in. 6061-T6 aluminum short columns were butt welded at midlength with root penetrations of 1/16, 1/8, and 1/4 in. Compression tests yielded 97%, 80%, and 72%, respectively, of the strength of a similar one-piece 6061-T6 aluminum column. Additional tests of columns of various lengths with 1/8-in. penetration welds yielded compressive strengths significantly better than similar columns with full-penetration welds. The advantage is greatest in columns of short and intermediate length; long columns buckle elastically, and their strength is governed by the modulus of elasticity rather than by the yield strength of the connection. Author

N64-29732 David Taylor Model Basin, Washington, D.C. Structural Mechanics Lab.
EFFECTIVE AREA OF RING STIFFENERS FOR AXIALLY SYMMETRIC SHELLS
R. D. Short Mar. 1964 19 p refs
(DTMB-1894; AD-601734)

The effectiveness of T- and I-section ring stiffeners, in axially symmetric shells undergoing axially symmetric deformations, is examined under the assumption that the thicknesses of the shell, flanges, and web of the stiffeners are small compared to the other dimensions. Curves are presented for obtaining the effective area and the flange stress of T-stiffeners. Approximate formulas for stiffeners with depth of stiffener small compared to the radius of the shell are also presented. Author

N64-29808 Hydronautics, Inc., Laurel, Md.
SOME RECENT DEVELOPMENTS IN THEORY OF BULBOUS SHIPS
B. Yim Aug. 1964 63 p refs
(Contract Nonr-3349(00))
(TR-117-6; AD-604352)

The necessity of a bulb for minimizing wave resistance is discussed, and a brief review of Inui's explanation of the bulb effect is given. Yim found the ideal bulb, or the doublet distribution on a semi-infinite vertical stem line, which completely cancels the sine regular waves starting from the stem of a given ship. For the cosine waves from the ship bow, a source line or a quadrupole line are considered. The separation of waves and the wave resistance into their components simplified the analysis, which was conducted, of the bulb effect at the bow or the stern. The size and the form of the bulb, which are functions of the ship shapes and Froude numbers, are supplied. The location of the bulb is related to the ship shape and the type of bulb. However, the higher order effect is found to be nonnegligible. (Throughout this report, inviscid, homogeneous, incompressible, and potential flow around a fixed ship is considered.) I.v.L

N64-30050 Hexcel Products, Inc., Berkeley, Calif.
DEVELOPMENT AND EVALUATION OF A LIGHTWEIGHT ALUMINUM HONEYCOMB CASE
M. N. Bandak 13 May 1964 21 p
(Contract DA-04-200-AMC-477(A))
(PR-4; AD-602367) OTS: $0.75

Drop testing, end drop testing, flat drop testing, and edge drop testing were performed on a lightweight-aluminum honeycomb case. Decelerations during end drops were within or close to the required 40 g's. In flat drop tests, decelerations were higher than the required maximum of 27 g's. In the edge drop test, a maximum peak of 65.6 g's was attained (perpendicular to longitudinal axis). A.W.

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